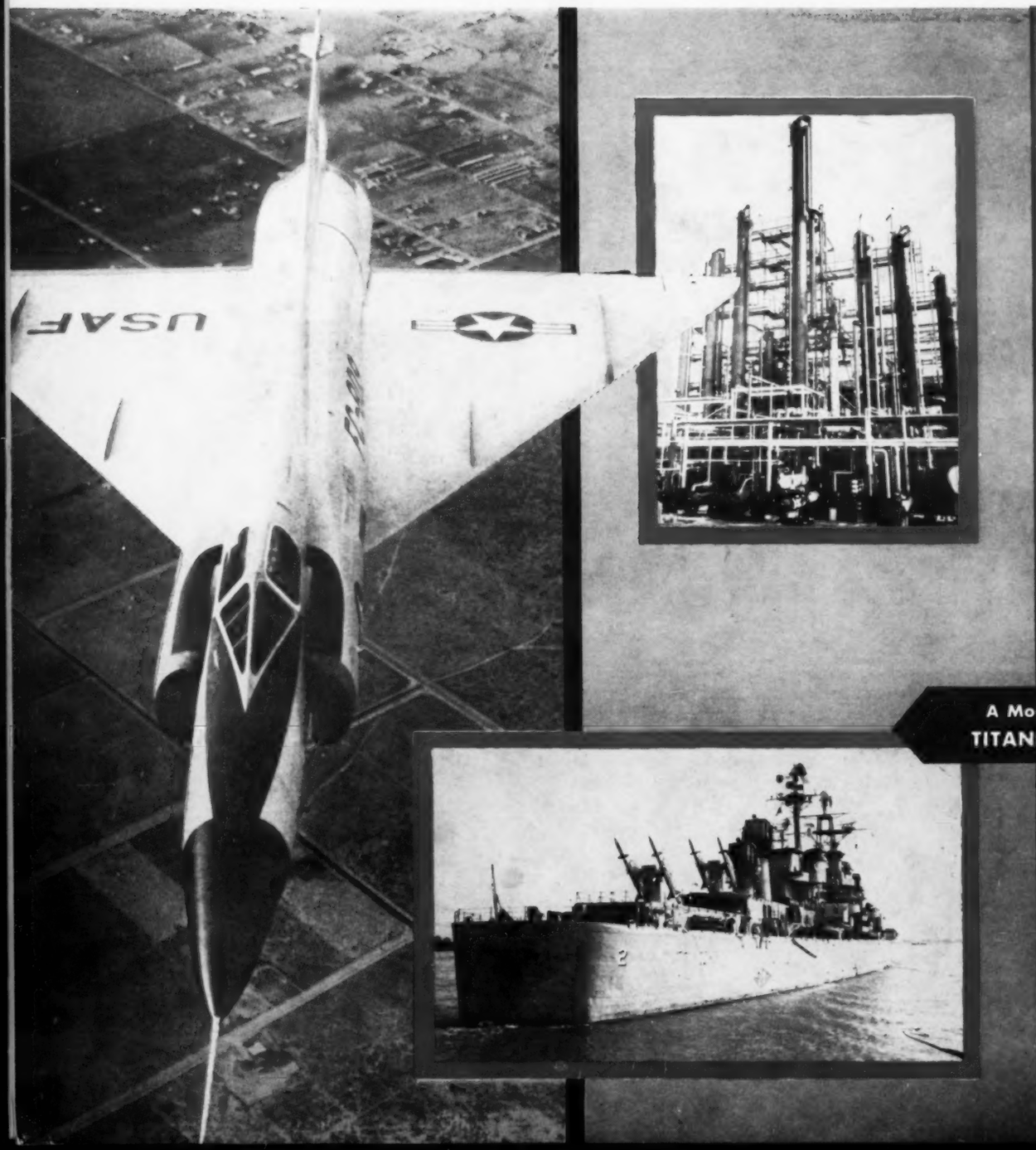
AUGUST, 1957

modern castings



Owned by

Is CO_2 Necessary?
University of Wisconsin research shows that the "CO_2" process will work without the use of CO_2 gas

Moving Foundry Materials
Method for analyzing materials handling problems in small shops is demonstrated with a case study

Steel Foundry Coremaking
Core baking time was cut 35-40% when St. Louis Steel Casting Inc. switched to a new type core binder

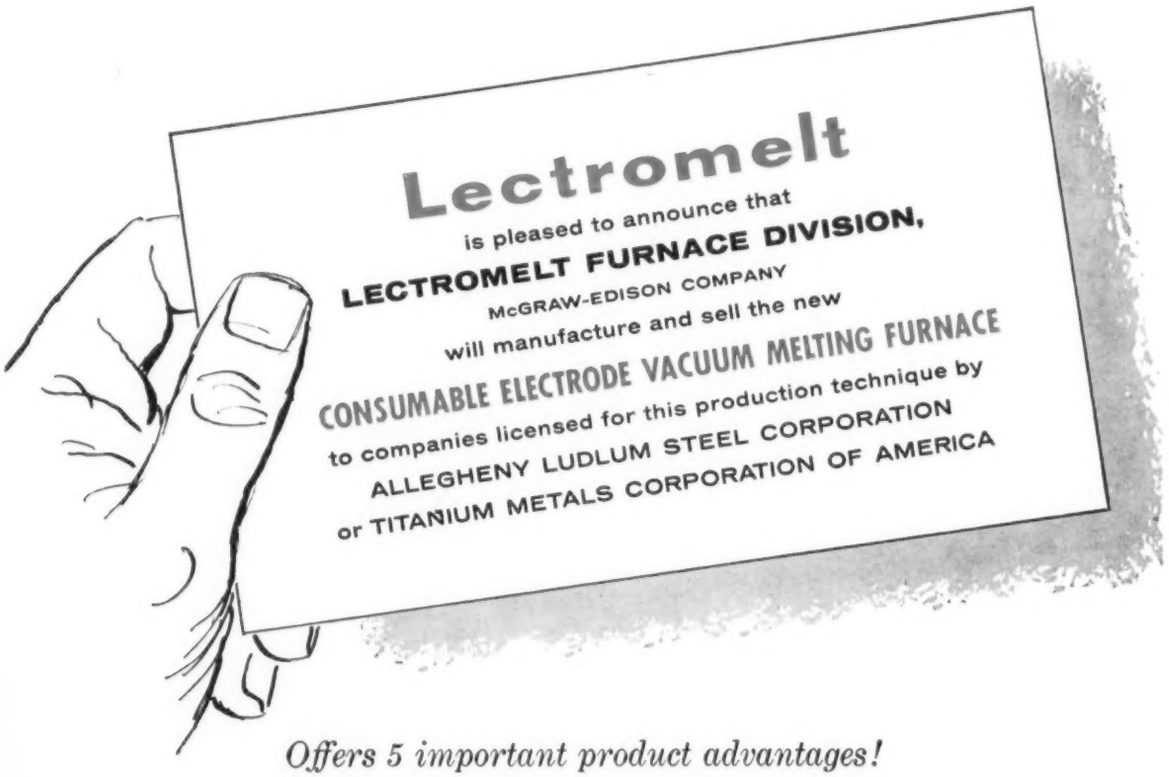
A Modern Castings Bonus
TITANIUM TECHNOLOGY

Leaking Air Inflates Costs
Learn to find and correct small leaks in pneumatic systems that can cause inflated operating costs for foundries

Penn State Conference
Summaries of talks presented at the first Penn State foundry conference feature useful shop information

The news is out!

PRODUCTION VACUUM MELTING OF
REFRACTORY METALS AND PRECISION SUPERALLOYS


Lectromelt
is pleased to announce that
LECTROMELT FURNACE DIVISION,
McGRAW-EDISON COMPANY
will manufacture and sell the new
CONSUMABLE ELECTRODE VACUUM MELTING FURNACE
to companies licensed for this production technique by
ALLEGHENY LUDLUM STEEL CORPORATION
or TITANIUM METALS CORPORATION OF AMERICA

Offers 5 important product advantages!

Test results on over 300,000 pounds of various nickel-base and iron-base superalloys hardened by titanium and/or aluminum additions show that remelting under vacuum by the consumable electrode process offers these distinct advantages over direct-arc furnace melted materials:

- Higher degree of cleanliness through removal of non-metallic inclusions and excess gases
- Better compositional homogeneity through freedom from segregation
- Improved workability and ingot soundness resulting in increased yields
- General improvement in mechanical properties
- Large homogeneous superalloy ingots at great speed and relatively low cost

For further details on vacuum remelting by the consumable electrode process or for electric furnace engineering service, write to

LECTROMELT FURNACE DIVISION
McGraw-Edison Company
316 32nd Street, Pittsburgh 30, Pennsylvania

Circle No. 121, Page 7-8

future meetings and exhibits

AUGUST

8-9 . . AFS Board of Directors, *Annual Meeting*. Hotel Sherman, Chicago.

11-15 . . American Society of Mechanical Engineers, *Heat Transfer Conference*. Pennsylvania State University, University Park, Pa.

19-24 . . *24th International Foundry Congress*, Arranged by Swedish Foundrymen's Association. Parliament Bldg., Stockholm, Sweden.

SEPTEMBER

8-13 . . American Chemical Society, *Fall Meeting*. New York.

9-13 . . Instrument Society of America, *Annual Instrument Automation Conference and Exhibit*. Cleveland Auditorium, Cleveland.

17-20 . . American Die Casting Institute, *Annual Meeting*. Edgewater Beach Hotel, Chicago.

19 . . American Management Association, *Annual Meeting*. Sheraton-Astor Hotel, New York.

23-24 . . Steel Founders' Society of America, *Fall Meeting*. The Homestead, Hot Springs, Va.

23-25 . . American Society of Mechanical Engineers, *Fall Meeting*. Statler Hotel, Hartford, Conn.

23-26 . . Association of Iron & Steel Engineers, *Exposition*. Sheraton Hotel, Pittsburgh, Pa.

27-28 . . AFS *Missouri Valley Regional Conference*. Missouri School of Mines and Metallurgy, Rolla, Mo.

OCTOBER

2-3 . . AFS *Michigan Regional Foundry Conference*. Michigan State University, Kellogg Center, East Lansing, Mich.

9-11 . . Gray Iron Founders' Society, *Annual Meeting*. Drake Hotel, Chicago.

12-13 . . Conveyor Equipment Manufacturers' Association, *Annual Meeting*. Grand Hotel, Point Clear, Ala.

17-18 . . Magnesium Association, *Annual Convention*. The Biltmore, New York.

17-19 . . Foundry Equipment Manufacturers' Association, *Annual Meeting*. The

Greenbrier, White Sulphur Springs, W. Va.

18-19 . . AFS *New England Regional Foundry Conference.* Massachusetts Institute of Technology, Cambridge, Mass.

18-19 . . AFS *Northwest Regional Foundry Conference.* Hotel Vancouver, Vancouver, B.C.

21-25 . . National Safety Council . . *45th National Safety Congress and Exposition.* Conrad Hilton Hotel, Chicago.

24-25 . . AFS *Niagara Frontier Regional Foundry Conference.* Statler Hotel, Buffalo, N. Y.

25-26 . . National Management Association, *Annual Meeting.* Penn-Sheraton Hotel, Pittsburgh, Pa.

31-Nov. 1 . . *10th Annual Purdue Metals Casting Conference.* Purdue University, Lafayette, Ind.

NOVEMBER

3-8 . . American Society for Metals and Society for Nondestructive Testing . . *2nd World Metallurgical Congress & 39th Annual National Metal Congress.* Morrison Hotel, Chicago.

7-8 . . National Foundry Association, *Annual Meeting.* Waldorf-Astoria Hotel. New York.

11-13 . . Steel Founders' Society of America, *Twelfth Technical and Operating Conference.* Carter Hotel, Cleveland.

DECEMBER

3-4 . . Foundry Facings Manufacturers Association, *Annual Meeting.* Hotel Waldorf-Astoria, New York.

4-6 . . American Institute of Mining, Metallurgical and Petroleum Engineers, *Electric Furnace Steel Conference.* Penn-Sheraton Hotel, Pittsburgh, Pa.

5-7 . . National Association of Manufacturers, *Annual Meeting.* Waldorf-Astoria Hotel, New York.

R. T. Kropf Heads A.S.T.M.

■ Richard T. Kropf, Belding Heminway Co., New York, was elected president of the American Society for Testing Materials at the 60th annual meeting held during June in Atlantic City, N. J. F. L. LaQue, International Nickel Co., New York, was elected vice-president.

Directors are: C. L. Clark, Timken Roller Bearing Co., Canton, Ohio; A. E. Juve, B. F. Goodrich, Brecksville, Ohio; J. H. Koenig, Rutgers University, New Brunswick, N. J.; R. E. Peterson, Westinghouse Electric Co., Pittsburgh, Pa.; and R. W. Seniff, Baltimore & Ohio Railroad Co., Baltimore, Md.

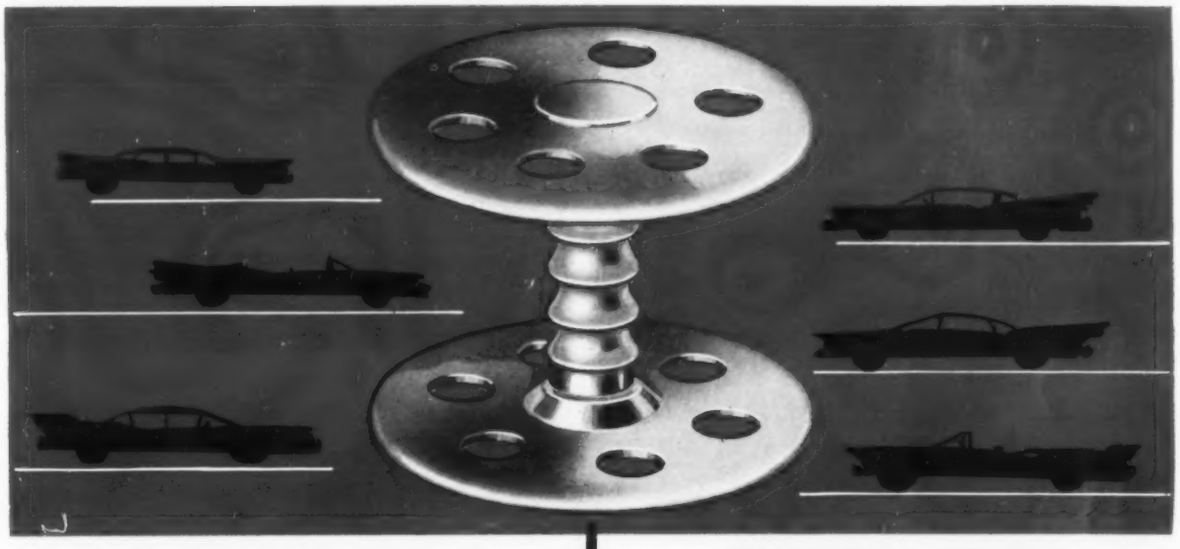
automobile styles may change...

but motor car manufacturers unanimously choose

fine **FANNER**

DOUBLE HEAD MOTOR CHAPLETS

for producing sound, uniform castings



The tremendous flow of uniform, sound castings necessary to the automotive industry must be maintained with no sacrifice in quality. That's why more Fine FANNER motor chaplets have been used by more producers of automotive castings than all other types combined.

Fine FANNER motor chaplets with their exclusive designs, their positive core support, accuracy of production and their complete fusion help produce better, sounder castings at lower cost.

Prevent costly product failures due to unsound castings by using fine FANNER motor chaplets for all your requirements.

Only a few of the wide range of motor chaplets made by FANNER are shown here — get acquainted with the complete line by writing today for your free copy of the FANNER Chaplet Catalog.

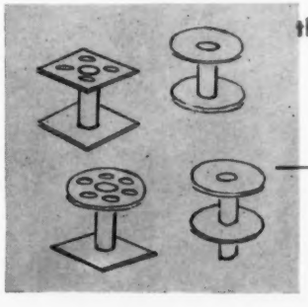
ENGINEERING SERVICE

Qualified and specialized engineers in Fanner's Technical Service Division are available for consultation, without obligation, on problems of producing more intricate castings; developing increased strength, closer tolerances, and better quality; reducing machining and improving finish — both in ferrous and non-ferrous castings. Take advantage of the research and development work that Fanner has invested in this field to improve your profit picture! Simply direct your request to the address shown below.

THE FANNER MANUFACTURING COMPANY

designers and manufacturers of fine FANNER CHAPLETS AND CHILLS

BROOKSIDE PARK CLEVELAND 9, OHIO

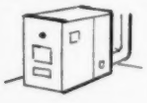


there are fine FANNER MOTOR CHAPLETS for many other products . .

pumps

road machinery

locomotives



furnaces

stoves

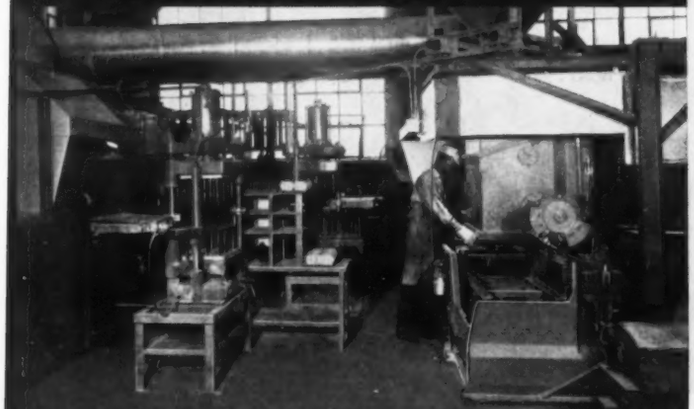
farm machinery

Circle No. 122, Page 7-8

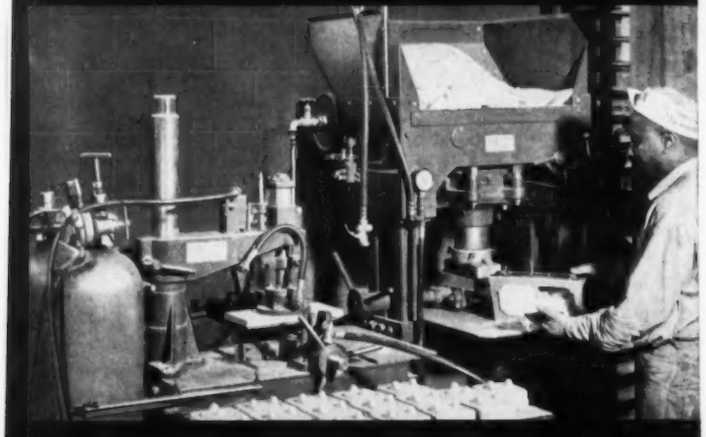
COMPLETE SHELL FACILITIES

at your service . . .

MOLDS—Newest production methods, latest equipment combine to produce high precision, low cost shells on quantity basis.



CORES—Automatic, economical CO_2 shell core-making facilities round out an efficient "mold-a-minute" precision production team.



CASTINGS—Close tolerance, smooth finish, non-ferrous shell-type castings are poured from metal melted in high frequency induction furnaces.

For fast service, fine dimensional accuracy and low over-all cost on small and medium size non-ferrous castings, look to City Pattern Foundry & Machine Company. Here you'll find, too, all the additional facilities . . . a complete, modern pattern shop, foundry, metallurgical laboratory and machine shop . . . that are required to provide an *all inclusive* service on top quality shell process castings.

City Pattern Foundry & Machine Company's experience in the shell process dates back ten years. As a result, here are shell facilities you can count on for all your jobbing needs. We'll be delighted to discuss your needs with you in detail. Why not call or write today.

CITY PATTERN
FOUNDRY AND MACHINE CO.
1161 HARPER AVENUE • DETROIT 11, MICH.
PHONE: TRinity 4-2000

Modifications Made in AFS Apprentice Contest Rules

■ In keeping with the industry's emphasis on appearance and soundness of castings, additional points will be awarded in these categories in the molding division of the 1958 Robert E. Kennedy Memorial Apprentice Contest.

Judges will score 20 points for gating and risering rather than the 30 formerly, general appearance has been increased from 15 to 20 points, soundness from 20 to 25 points, and cleanability lowered from 15 to 10 points.

In the metal pattern division points for workmanship have been reduced from 40 to 30 points and points for time increased from 10 to 20.

The 1958 contest opens October 1, 1957 and closes April 7. All patterns and castings qualifying for national judging must be received prior to 5 pm, Monday, April 7, by Prof. Roy W. Schroeder, General Engineering Dept., University of Illinois, Pier 47, Chicago. Patterns and castings should not be sent to the National Headquarters.

Eligibility is open to any apprentice or trainee in the metal castings industry with no more than 5 years pattern experience or no more than 4 years experience in molding.

Rules and regulations of the Apprentice Contest were completely revised June 7 by the Apprentice Contest Committee. The new regulations will be sent to all Chapters.

Other modifications by the committee:

■ Where Chapters hold local elimination contests, any and all entries from plants located within the Chapter's territory must be judged in the local contest.

■ All Chapters and plants intending to hold local elimination contests must promptly furnish the AFS Headquarters the name of one person to serve as the official contact for all correspondence concerning the contest. That person will also receive all contest materials and instructions.

The committee also recommended that consideration be given to x-raying of molded entries in the national contest showing no serious visible defects.

Complete information regarding the Apprentice Contest can be obtained by contacting the Education Director, American Foundrymen's Society, Golf and Wolf Rds., Des Plaines, Ill.

Circle No. 123, Page 7-8

august, 1957
vol. 32, no. 2

modern castings

in this issue

BONUS SECTION

Is CO_2 Necessary? / Carl E. Wulff 28
Moving Foundry Materials—No. 3 / Ralph A. Petersen 30
Technology For Casting Titanium 33
Leaking Air Inflates Cost / Charles Briwa 49
Penn State Conference / J. H. Schaum 51
Steel Foundry Speed Coremaking / Earl Bewig / David McGowan 52
AFS Chapter Officers Discuss Broad Scope of Activities 54

regular departments

Future Meetings & Exhibits ..... Inside Front Cover
Products & Processes 6
Let's Get Personal 14
Editor's Field Report 20
Pouring Off the Heat 24
For The Asking 25
Local Foundry News 62
AFS Chapter Meetings 65
Committees in Action 65
The SHAPe of Things / H. J. Weber 66
Question & Answer Department 68
Obituaries 69
Foundry Trade News 71
Patent Review / Melvin Nord 72
Dietrich's Corner / H. W. Dietrich 75
Classified Advertising 79
Castings Through the Ages 79
Advertisers and Their Agencies 80

FOUNDRY TECHNICAL CENTER, Golf & Wolf Roads, Des Plaines, Ill.
VAnderbilt 4-0181

WM. W. MALONEY, *General Manager*

JACK H. SCHAUM, *Editor*
PAUL R. FOGHT, *Managing Editor*
GEORGE A. MOTT, *Assistant Editor*
VIRGINIA SUTTERBY, *Production Editor*
CURTIS G. FULLER, *Editorial Consultant*

J. M. ECKERT, *Advertising Manager*
JAMES C. KURZ, *Midwest District Manager*

Contributing Editors

S. C. MASSARI, *Metallurgical*
H. J. WEBER, *Safety, Hygiene, and Air Pollution Control*
A. B. SINNETT, *Education*

Branch Offices

Cleveland—14805 Detroit Ave., ACademy 2-2433, WM. I. ENGLEHART, *District Manager.*

New York—Grand Central Terminal MUrray Hill 6-4670, HERB J. OLSOW *District Manager*

MODERN CASTINGS is indexed by Engineering Index, Inc., 29 West 39th St., New York 18, N. Y. and microfilmed by University Microfilms, 313 N. First St., Ann Arbor, Mich.

Published monthly by the American Foundrymen' Society, Inc., Golf & Wolf Roads, Des Plaines, Ill. Subscription price in the U.S., $5.00 per year; elsewhere, $7.50. Single Copies 50c. May and June issues $1.00. Second-class mail privileges authorized at Pontiac, Illinois. Additional entry at Des Plaines, Ill.

AUDITED PAID CIRCULATION ABC

On The Management Side

■ **Using Older Workers in the Foundry.** As we all grow older we become increasingly conscious of age limitations placed on jobs. That last sentence, "men over 35 need not apply," or "applicant should be between 25 and 35 years of age" makes you feel like you are "over the hill" thirty years too soon.

The July issue of MODERN CASTINGS featured a report by the U.S. Department of Labor in which a survey showed that foundry workers were, on the average, older than workers throughout all non-agricultural industry. More than 26 per cent of the patternmakers proved to be over 55. Similarly, about 25 per cent of the hand, bench molders were in the "over 55" category. Is this good or bad? Are older workers an asset or liability?

According to a study by the Small Business Administration, management too often has the opinion that among older employees there is greater absenteeism, higher accident rate and less productivity. True or false?

■ **Absenteeism.** In a survey of almost 18,000 employees in over 100 companies, it was found that the absentee rate decreased consistently as age increased. Workers under 20 years of age average six days absence out of every 100 days while those over 45 miss a little over three days.

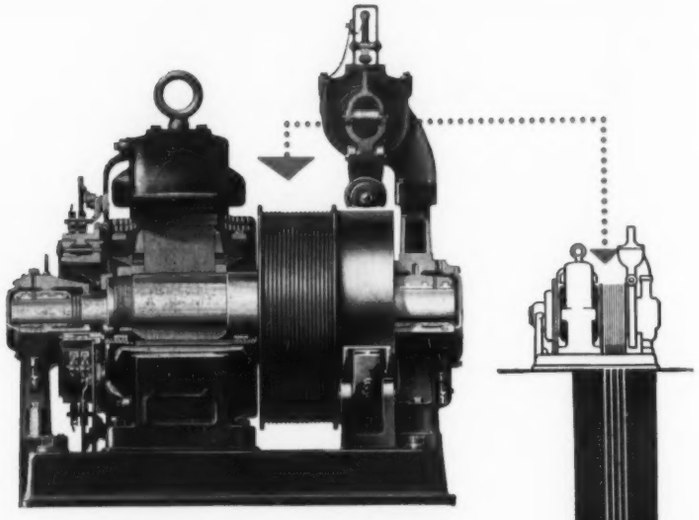
■ **Accident Rate.** As workers grow older, they tend to become more safety conscious and show a lower injury rate. Older workers are more careful and take fewer risks. The highest frequency rate of disabling injuries is in the age group 25-29 while the lowest is in the 70-74 group.

■ **Productivity.** Indications are that output stays about the same in most people up through age 55. After that productivity begins to gradually fall off. Actually there are greater individual differences within the same age group than between different age groups. In other words a superior worker will maintain this mark in older age while a lazy worker will not improve with age. What an older worker may lose in speed he gains in patience, carefulness, and accuracy.

■ **Other Factors.** Older employees are more likely to stay with their company, are more loyal, and are more appreciative of what is done for them. Older employees often need less supervision than the younger ones. They are more experienced, have broader knowledge, and are more stable.

With "quality castings" being the goal of most foundries there are increasing needs for careful inspection and control of all foundry operations. What better qualifications are there for inspectors and quality control supervisors than men who are on the job, loyal, experienced, stable, conscientious, careful, and accurate? With foundry mechanization taking the place of young muscles, productivity will be less influenced by age of workers.

We all want to grow old—lets utilize not penalize this once-in-a-life-time privilege.



Otis Elevators Use HANNA PIG IRON

to support their ups and downs

Rough finishing a one-piece sheave rim and brake pulley casting in the Otis Elevator Company's Yonkers foundry.

Center of action in the mechanism of Otis Elevator Company's high-speed (up to 1,400 ft. per minute) Autotronic passenger elevators is the one-piece cast iron drum shown in place in the top picture and in rough form below. Half of the drum serves as a sheave rim for the elevator's cables, the other half as a brake pulley. To maintain the high standards of quality and performance demanded of these drums, Otis Elevator's foundry at Yonkers, N. Y., casts them with Hanna Pig Iron.

The Hanna range includes the Hanna 38-pound pig, the foundryman's favorite standard, in all grades, silvery and HannaTite, a specially controlled, close-grain iron. Also available is the HannaTen, a smaller ingot, with finer grain structure and no free carbon pockets. For prompt, expert handling of your pig iron requirements, call your Hanna representative at any time.

HANNA
BEST KNOWN NAME IN IRON

THE HANNA FURNACE CORPORATION
Buffalo • Detroit • New York • Philadelphia
Merchant Pig Iron Division of
NATIONAL STEEL CORPORATION

Circle No. 124, Page 7-8

Periodic Examinations Key to Controlling Radiation

■ Engineering control of beta and gamma radiation offers the best and safest method of protecting foundry workers from exposure. However, engineering should be supplemented by medical control.

Certain body tissues are more responsive to the effects of ionizing radiation than others. It appears that white blood cells derived from lymphatic tissue are the most sensitive, followed by immature red cells, the sperm-producing areas of the testes, some cells of the bone marrow, the basal cells of the skin, the connective-tissue cells, cells of the bone, liver, pancreas, kidney, nerves, brain, and muscles.

Watch Abnormal Changes

Because of the wide distribution and fundamental functions of the blood-forming tissues, and their extreme sensitivity to radiation effect, the detection and measurement of abnormal changes in such tissues should be the best early indication of radiation exposure.

In medical control, emphasis should be placed on the detection of trends in the blood picture in reference to what has been established as normal for the particular individual. Examinations of blood, marrow, and urine should not be depended upon to indicate early radiation exposure.

Give Periodic Checks

These regular checks should be complemented by periodic health histories with emphasis on symptoms. The examination should consist of a red cell count, hemoglobin determination, white cell count, differential count, and estimation of blood platelets.

Pre-employment examinations and periodic checks every two or three months will enable employers to remove susceptible workers from exposure. These interval health histories and symptomatology are just as important as blood examinations in detecting early indications of radiation exposure.

Based on a study of a number of patients undergoing radiation therapy, it has been suggested that the finding of a low level of white cells which stain with eosin could be indicative of susceptibility of the individual to radiation sickness.

This article is based on the "Internal Indicators of Radiation Exposure" chapter of the American Foundrymen's Society RADIATION PROTECTION MANUAL which will be released soon.

Castings Have Opportunity In Nation's Air Program

JOHN H. GARRETT /
*Office of Asst. Secretary of Defense**

■ Consistent high-quality production of steel castings meeting strength-weight requirements can open the door to increased use of castings in the aircraft industry.

The potential would amount to only a few thousand tons yearly at current procurement levels, but the total business from these necessarily high-priced castings would be substantial. If feasible production methods can be obtained for aircraft quality castings, it is probable that greater use of castings would be made in other categories of military weapons and equipment.

Changes in aircraft design accompanying higher speeds and higher temperatures have been in the direction of larger size, heavier gross weights, and thinner air foils. This combination has meant much heavier loads in critical stress-carrying members and has lead to use of stronger materials with greater section thickness.

There has been a pronounced trend toward the use of a greater percentage of steel or titanium at the expense of aluminum. As speeds are extended farther, the trend away from aluminum and magnesium, toward steel, titanium, and ultimately super-alloys will accelerate.

Airplanes and guided missiles are conventionally made of sheet metal and forgings with an occasional extrusion or casting. However, the typical aircraft fitting is not well adapted to forging because of:

- Excessive machining.
- Difficulty in close tolerances.
- High cost of forging dies.
- High overhead rates.
- Shortage of die making capacity.

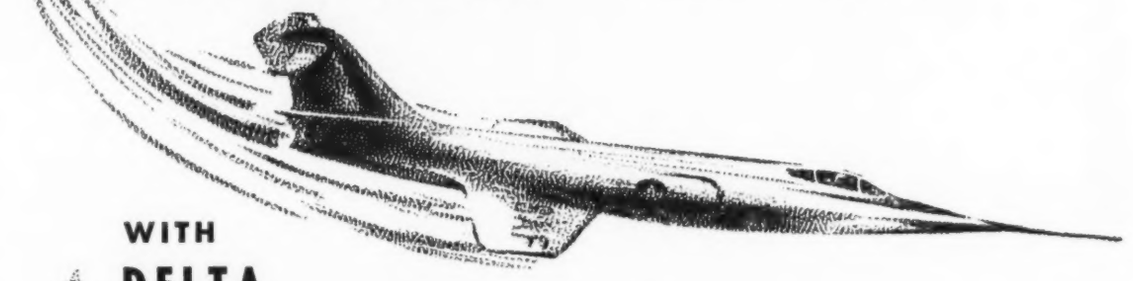
Currently the use of steel castings in aircraft is less today than during World War II in proportion to the number being manufactured.

The problem of foundries in developing castings to meet aircraft specifications appears to be not so much development of improved techniques or improved castings alloys, as the establishment of standards of quality and improved inspection methods to insure standards are maintained.

The Aircraft Industries Association's Aircraft and Technical Committee has established a group to study this problem, and attempt to derive more useful and logical standards and test methods for castings.

*This article is based on a talk presented by Mr. Garrett at the Investment Casting Institute, May 1.

COVER GREATER SURFACE AREA
...AND GET
SMOOTHER...
CLEANER CASTINGS...at lower cost!



WITH
DELTA
SUPERKOAT WASH
FOR ALL TYPES OF METALS

Delta SuperKoat Wash is recommended for Steel, Gray Iron, Malleable and Non-Ferrous castings. It's easy to mix and apply uniformly to green or dry sand and baked core surfaces by dipping, swabbing, spraying or brushing.

Working samples and complete literature on Delta Foundry Products will be sent to you on request for test purposes in your own foundry.

NOTE THESE IMPORTANT ADVANTAGES OF DELTA SUPERKOAT WASH:

1. NO PRECIPITATION OR SETTLING — When thoroughly mixed, wash will stay in suspension indefinitely.
2. EASY TO APPLY — It can be dipped, swabbed, brushed or sprayed on green or dry sand and baked surfaces.
3. RAPID, DEEP PENETRATION & EXCELLENT ADHESION — Quickly anchors itself 5 to 7 grains deep in sand surfaces.
4. NON-REACTIVE — LOW GAS — Will not react or produce gas in contact with molten metal.
5. REDUCED CLEANING COSTS — Cast surfaces are smoother and castings are cleaner.
6. WILL NOT FLAKE — When completely dried, the wash is thoroughly bonded to the sand surfaces.
7. HIGHLY REFRACTORY — Has an unusually high fusion point.
8. ELIMINATES SAND FUSION AND BURN-ON — Flowing metal will not crack or rupture wash during pouring.
9. ECONOMICAL TO USE — Covers a greater surface area at a lower cost per pound of wash.

DELTA

DELTA OIL PRODUCTS CO.
MANUFACTURERS OF SCIENTIFICALLY CONTROLLED FOUNDRY PRODUCTS
MILWAUKEE 9, WISCONSIN

Circle No. 125, Page 7-8

America's leader in metal abrasives . . .

For over 70 years, Pittsburgh Crushed Steel Company has consistently led the metal abrasives industry—has led in research and product development—has led in the improvement of production methods—and has led in sales and service facilities as well as in distribution facilities!

The results have been better metal abrasives for lower cleaning costs in foundries, forge plants, and steel and metal working plants in general!

Today, through 13 distributing points and 33 sales-service offices, we supply all sizes and types of metal abrasives, iron and steel, for every type of blast-cleaning equipment and for every blast-cleaning requirement!

Our engineering, sales, and service representatives are always available to you in connection with your blast-cleaning needs.

PITTSBURGH CRUSHED STEEL COMPANY

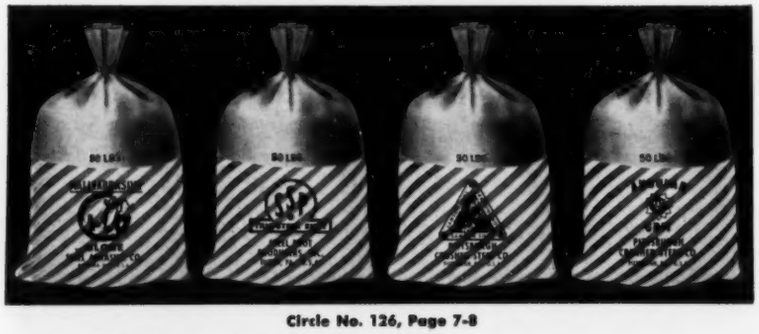
Arsenal Sta. Pittsburgh (1), Pa.

Subsidiaries: Globe Steel Abrasive Co., Mansfield, Ohio

Steel Shot Producers, Butler, Pa.

NOW SOLD IN 50-LB. DOUBLE BURLAP BAGS

Sold by Pangborn Corp., Hagerstown, Md., and by leading distributors of foundry supplies from coast to coast.



Circle No. 126, Page 7-8

products and processes

Brass passifier also prevents tarnishing in one application. Can be sprayed, dipped, or brushed to provide a durable coating which resists humidity. *Logo, Inc.*

For Manufacturer's Information Circle No. 1, Page 7-8

Casting cart, rubber-tired, two-wheeled, carries loads at working height. Pan is separate unit and can be removed for use with conveyor

track. Unit weighs 129 lb., has 700-lb. capacity. Carts can be dove-tailed to form a continuous line. *Nomad Equipment Div., Westover Corp.*

For Manufacturer's Information Circle No. 2, Page 7-8

Conveying system at Indiana foundry permits man to operate two airless blast machines and move castings from grinders to cleaning mills and inspection stations.

The powerless system consists of two shuttle cars (A and B) which roll on tracks (C and D) and four banks of rollers (E, F, G, and H).

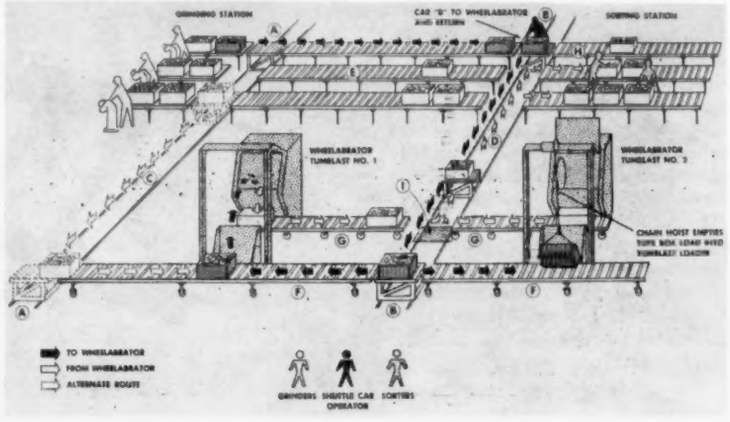
Conveyors at E carry tote boxes from the grinders; conveyor F takes them to the blast machine loaders; conveyor G moves them to the unloading stations; and conveyor F takes the boxes to the inspectors.

A hydraulic lift is used at G to permit positioning of the boxes. Tote boxes are unloaded by attaching chain hoist at the rear and tipping. After dumping, boxes are conveyed to the front of mill for unloading and then moved to inspection stations. *Wheelabrator Corp.*

For Manufacturer's Information Circle No. 3, Page 7-8

Flame-cutting nozzle made of two pieces is said to increase speed of cutting with oxygen and fuel gases.

Numerous small outlets increase rate



Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 83, Sec. 34.9 P. L. & R. DES PLAINES, ILL.

MODERN CASTINGS
Golf & Wolf Roads
Des Plaines, Illinois

Subscribe to MODERN CASTINGS

Help yourself to these cards and do yourself a favor. If you don't belong to the American Foundrymen's Society, send in the top card and start to read the most popular magazine in the industry regularly. If you want more information on the products advertised or listed in this issue, send us one of the postage-free reader service cards below and we'll do all the rest.

Send for FREE DATA

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 83, Sec. 34.9 P. L. & R. DES PLAINES, ILL.

Reader Service Dept.
MODERN CASTINGS
Golf & Wolf Roads
Des Plaines, Illinois

Please type or print 57/8

Please have information or bulletins indicated by circled numbers sent to me without obligation.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

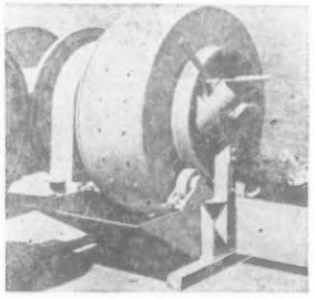
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Please use card before February 1, 1958

deterioration from aging, weather, abrasion, acids, oils, and moisture. Available in 1-¼ to 26-in. ID and three hose types. *Flexhaust Co. Div., Callahan Zinc-Lead Co.*

For Manufacturer's Information Circle No. 8, Page 7-8

Metal reclaiming mill has automatic re-circulation of water in a closed



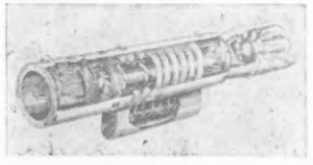
circuit system to separate and concentrate the metallics concealed in skimmings, slag, and sweepings for remelting. Available in four sizes. *Dreishbach Engineering Corp.*

For Manufacturer's Information Circle No. 9, Page 7-8

Vinyl enamel coating for protecting machinery can be applied without interrupting work schedules. Nonflammable during application and fire resistant when dry. Resists damaging effects of oil, grease, fumes, moisture, and mild acids. Dries to the touch in 1 hr and dust free in 4 hr. *Wooster Finishes Corp.*

For Manufacturer's Information Circle No. 10, Page 7-8

Dust collector, wet, inertial type, is a cylindrical device having two essential parts; a mixer section and eliminator section. Dust-laden air or gas

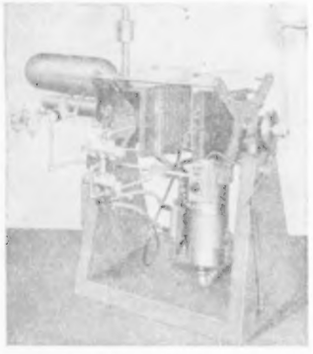


enters at the mixer, impingement takes place at 4500-6000 lineal ft per min. Dust particles are enveloped in water by a fine spray. Dust passes through turning vanes as it enters the eliminator section. The vanes impart a helical motion causing centrifugal force to separate entrained particles from the air. Dust-laden water is captured at the periphery of the eliminator section in blind louvres which are connected to a disposal sump at the bottom of the unit. Cleaned air passes out of the eliminator through straightening vanes which recover energy of rotation, reducing over-all draft loss. Unit may be mounted in existing duct

of heat transfer with gases flowing at 1200 ft per sec. Nearly solid ring of preheat flame gives uniformity. *Linde Co. Div., Union Carbide Corp.*

For Manufacturer's Information
Circle No. 4, Page 7-8

Shell core blower, manually operated, is designed for small core production



at rates of 35-40 sec per cycle. Electrically-heated plates are 10 x 15 in. *Shell Equipment, Inc.*

For Manufacturer's Information
Circle No. 5, Page 7-8

Industrial x-ray unit assures high quality radiographs of materials ranging from 3-in. thick steel castings to thin magnesium sections. Portable 200 KV unit weighs 85 lb and is equipped with automatic protection devices. X-ray head is suspended inside frame for protection in field use. *Balteau Electric Corp.*

For Manufacturer's Information
Circle No. 6, Page 7-8

Welding helmet plastic cover plate, made of aluminized cellulose acetate, protects against radiant heat. Windows permit longer work periods and increased efficiency on metal pouring and furnace operations. Evaporated

aluminized coating reflects more than 70 per cent of radiant heat normally reaching the worker's face. *Safety Products Div., American Optical Co.*

For Manufacturer's Information
Circle No. 7, Page 7-8

Flexible hose for grinder connections, exhaust hoods, and materials handling is easily cut, bent and shaped. Weighs one-third of metal ducts and resists

YES! . . . **I want to receive MODERN CASTINGS regularly.**

Enter my subscription for one year at $5.00 in U.S., $7.50 elsewhere.

☐ Payment is enclosed ☐ Bill me later

Name ..... Position or Title ..... (Important)

Address ☐ Home ☐ Business .....

City ..... Zone ..... State .....

Company .....

Subscribe to MODERN CASTINGS

Help yourself to these cards and do yourself a favor. If you don't belong to the American Foundrymen's Society, send in the top card and start to read the most popular magazine in the industry regularly. If you want more information on the products advertised or listed in this issue, send us one of the postage-free reader service cards below and we'll do all the rest.

Send for FREE DATA

Please type or print 57/8

Please have information or bulletins indicated by circled numbers sent to me without obligation.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____ State _____

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140
141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200
201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220
221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240

Please use card before February 1, 1958

Postage Will be Paid by Addressee

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 83, Sec. 34.9 P. L. & R. DES PLAINES, ILL.

Reader Service Dept.
MODERN CASTINGS
Golf & Wolf Roads
Des Plaines, Illinois

work at the point of use. Unit rated at 40,000 cfm weighs 2500 lb. *Joy Mfg. Co.*

For Manufacturer's Information Circle No. 11, Page 7-8

Overhead crane package kit is available for assemblies up to 4000 lb capacity and spans up to 30 ft. Kit contains two truck frames, four crane

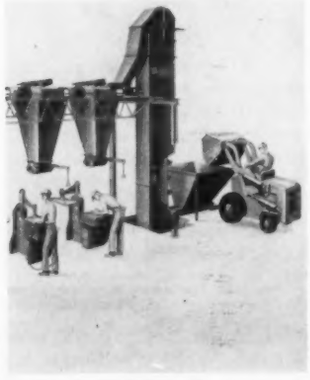
trolleys, and all necessary bolts and fittings. User supplies crane beam and angle end stops. *Becker Crane & Conveyor Co.*

For Manufacturer's Information Circle No. 12, Page 7-8

Resin metering device pumps and delivers measured quantities of epoxy, polyester resins and hardeners in fiber glass fabricating operations. Delivers as small as 10 grams and up to 3 lb. *Auto-Air Industries, Inc.*

For Manufacturer's Information Circle No. 13, Page 7-8

Overhead sand system built as package unit, eliminates piling of sand on floor. System is filled with front-end loader. Conditioned sand is dis-



charged onto flat belt conveyor with plows for diverting sand into each molder's hopper. *Foundry Div., Jeffrey Mfg. Co.*

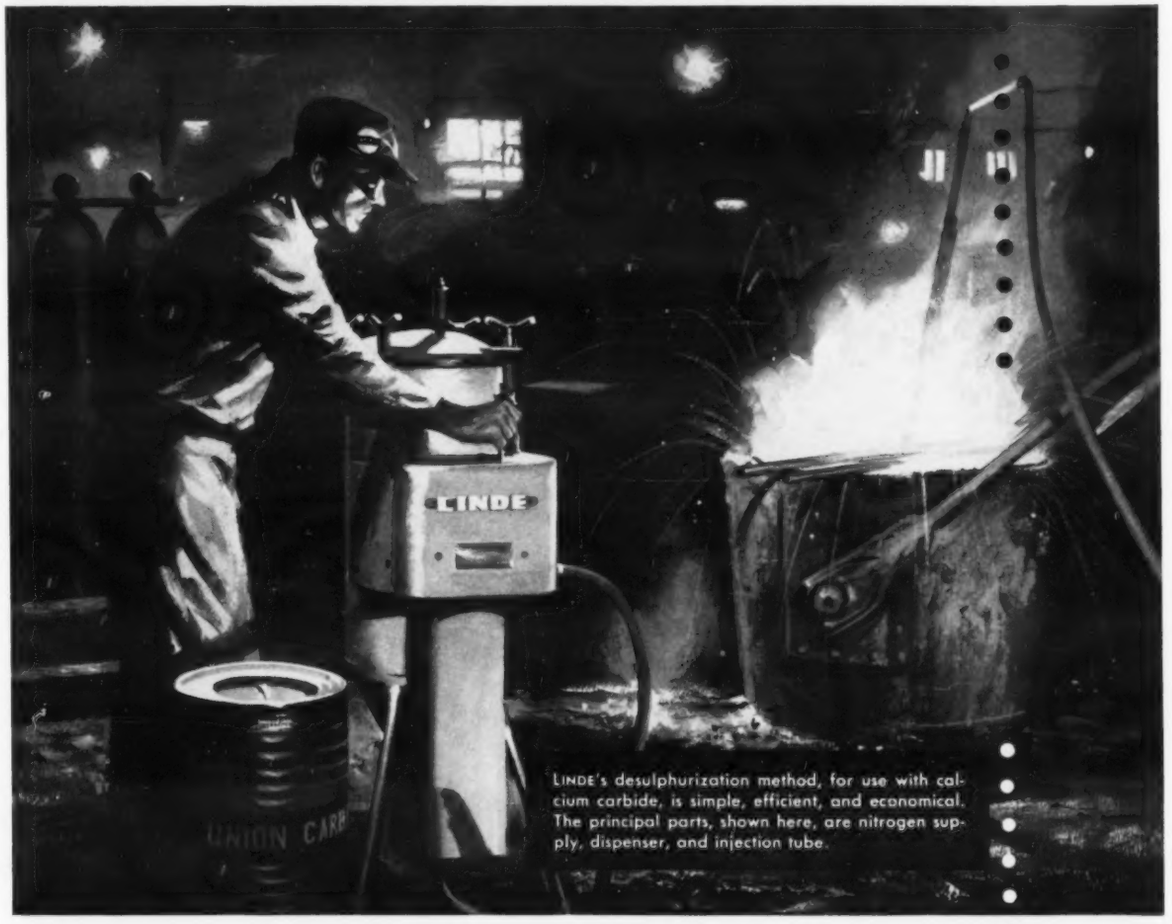
For Manufacturer's Information Circle No. 14, Page 7-8

Wear-resistant liners for blast cleaners are available in types for constant or intermittent use. Liners promote savings through less maintenance and continuous production. Available for wheel housing, drum heads and other parts subject to severe abrasion. *Pangborn Corp.*

For Manufacturer's Information Circle No. 15, Page 7-8

Hardness tester, portable, eliminates need for calculations or conversions

DESULPHURIZATION...



LINDE's desulphurization method, for use with calcium carbide, is simple, efficient, and economical. The principal parts, shown here, are nitrogen supply, dispenser, and injection tube.

You get uniform results with Metallurgical Carbide from LINDE

In the foundry, you can produce high grade iron only by making sure you use metal with a low sulphur content. As a desulphurizing agent, metallurgical calcium carbide assures *uniformity* in the metal you produce. You know in advance that by adding a certain amount of carbide you remove a certain percentage of sulphur. Because metal specifications can be met efficiently and economically with carbide, you eliminate any need for wasteful "trial and error" methods.

Linde's method of mixing UNION calcium carbide and molten iron is simple and sure. A stream of fine mesh carbide and nitrogen under pressure is forced from a dispenser through a hose. The graphite injection tube is immersed deep in the hot metal. The carbide blends evenly and thoroughly with the iron. Desulphurization with UNION calcium carbide creates no fumes, does not attack refractories. The LINDE equipment—nitrogen supply, dispenser, and injection tube—is easy to operate and maintain.

If you would like more information about LINDE's method of desulphurization, using calcium carbide, just call or write your nearest LINDE office. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Linde
TRADE-MARK

UNION CARBIDE

The terms "Linde," "Union" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Circle No. 127, Page 7-8

Here's what Federal Malleable thinks about the new HA "PAYLOADER":

It has a bigger bucket capacity, yet its short turning radius and maneuverability has been retained. The 40° bucket roll-back at ground level is a big improvement in getting bigger loads into the bucket and carrying them in a low, close and more stable position. The torque converter drive also is a great feature as it makes operating the HA simpler and faster, and cushions the entire drive train.

"Our entire operation is dependent on the fast handling we get from our 'PAYLOADER' units and, so far, they haven't let us down," says N. N. Amrhein, Assistant General Manager at Federal Malleable of the Model HA tractor-shovel. "For all the good service they've given us, we can't afford to take a chance on anything less reliable."

Producers of castings since 1902 in Milwaukee, Wis., Federal Malleable has used "PAYLOADER" tractor-shovels as a vital part of their sand preparation system for 10 years. Four HA units are used at present "to scoop up the sand and castings after the daily pour and carry them to the oscillating conveyor. They also pick up reprocessed sand and deliver it to the molding stations."

Smallest of the "PAYLOADER" line, the Model HA has a 2,000 lb. carrying capacity. Operating features include rear wheel steering, one-lever bucket control, two speeds in either direction, and these optional attachments: Fork lift, castings bucket, pick-up sweeper and castered scrap hoppers. Call your nearby Distributor for a demonstration on what a Model HA or larger "PAYLOADER" can do to speed up your handling duties.

THE FRANK G. HOUGH CO.
711 Sunnyside Ave., Libertyville, Ill.

Send more "PAYLOADER" information on:

☐ Model HA (2,000 lb. carry capacity)
☐ Larger models (up to 9,000 lb. carry capacity)

NAME_____
TITLE_____
COMPANY_____
STREET_____
CITY_____ STATE_____

114

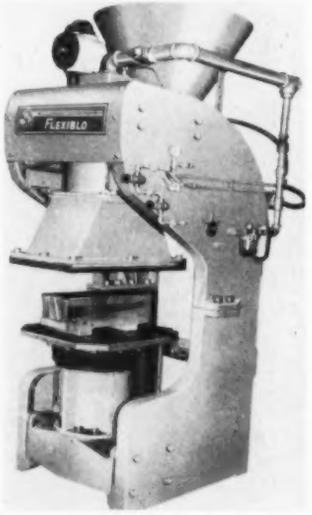
SAY "HUFF"

PAYLOADER®
MANUFACTURED BY
THE FRANK G. HOUGH CO. LIBERTYVILLE, ILL.
SUBSIDIARY—INTERNATIONAL HARVESTER COMPANY

by giving readings in Rockwell or Brinell. During impression the specimen hardness causes penetrating mechanism to hydraulically force a fluid into capillary tube under the dial. Six ranges are available. Weighs only 30 oz. *Newage Industries Inc.*

For Manufacturer's Information
Circle No. 16, Page 7-8

Core blowing machine features dial setting for any one of three operations: high pressure blow, regulated pressure prefill followed by high pressure blow, or regulated pressure pulsating blow. Unit blows cores using



any sand within practical foundry limits. Core boxes requiring a deep accurate draw are handled by 10-in. hydraulic-controlled draw with adjustable speed. Has all-pneumatic control circuit with hydraulic draw cylinder, hydraulic table height adjustment and diaphragm vertical core box clamp. *Beardsley & Piper Div., Pettibone Mulliken Corp.*

For Manufacturer's Information
Circle No. 17, Page 7-8

Powder blower for magnetic particle testing weighs 2-¼-lb. Covers wider area faster and more evenly than shaker-type powder bulbs. Operates

from air lines using 20 psi. Adjustment controls powder density, two buttons used for selecting powder or clean air. *Magnaflux Corp.*

For Manufacturer's Information
Circle No. 18, Page 7-8

Sandblast cabinet may be used with adjustable-mounted blast unit or hand

Circle No. 128, Page 7-8

blast gun. Mounted unit may be raised or lowered in cabinet with action controlled by foot valve.
Cyclone Sandblast Equipment Co.
For Manufacturer's Information Circle No. 19, Page 7-8

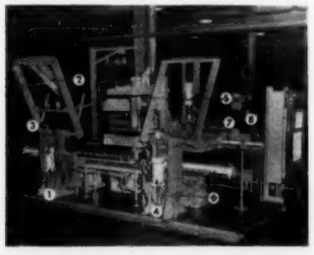
Shell core machine features direct heat application to core box, a simple clamping method and flexibility in making core sizes and shapes. *Frederic B. Stevens, Inc.*
For Manufacturer's Information Circle No. 20, Page 7-8

Aluminized asbestos suit allows working in areas over 2500 F. Protective cloth reflects more than 90 per cent

of radiant heat. Aluminum foil surface resists water, oil, sparks and cinders. *Keasbey & Mattison Co.*
For Manufacturer's Information Circle No. 21, Page 7-8

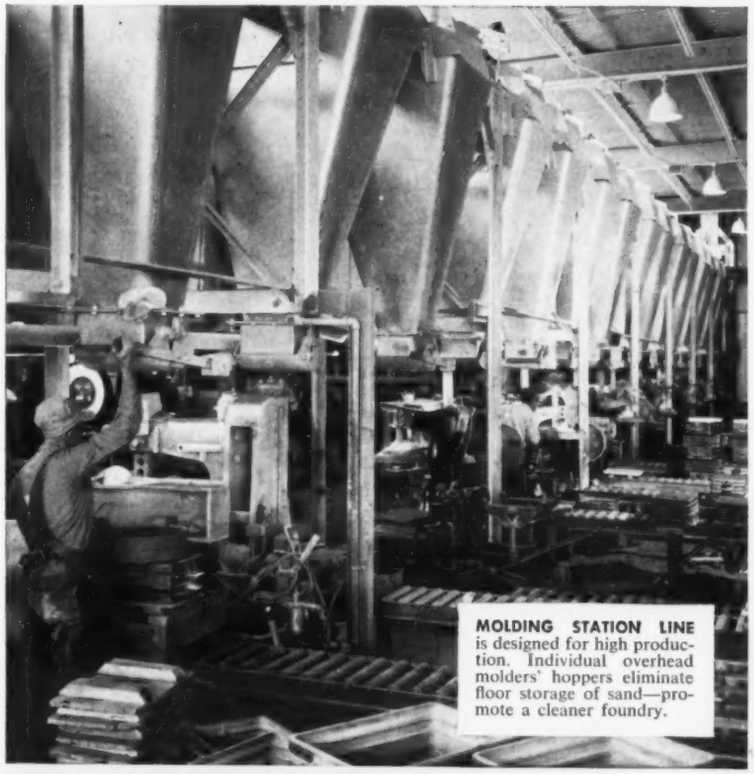
Core additive is vehicle added to graphite or talc and applied to cores or molds by dipping or spraying. Said to build up insulating medium between metal and core and gives smooth surface preventing metal penetration. When mixed heavily with refractories it smooths out irregularities. *United Oil Mfg. Co.*
For Manufacturer's Information Circle No. 22, Page 7-8

Double-jolt-molding machine, available in 750-10,000 lb capacities, is designed for long or short runs. Cope flask jolt operations are followed by,



and interlocked with drag flask jolt operations. Both operations, once started, are automatically followed

Why LINK-BELT-mechanized sand handling consistently increases production, improves working conditions



MOLDING STATION LINE is designed for high production. Individual overhead molders' hoppers eliminate floor storage of sand—promote a cleaner foundry.

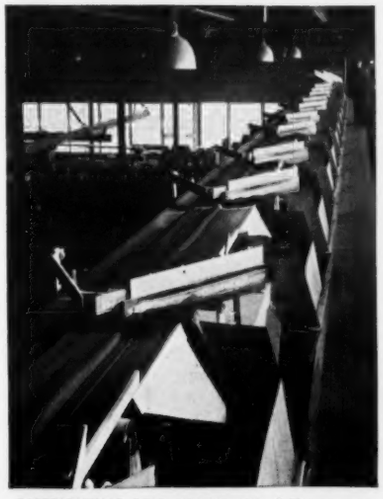
System at A. B. Chance non-ferrous foundry holds down unit costs, utilizes maximum use of manpower

LIKE other progressive foundries all over the country, A. B. Chance Co. of Centralia, Mo., has found Link-Belt sand handling mechanization the key to more profitable operations. By improving the quality of their prepared sand, this foundry reduced scrap and increased production. Also, working conditions were improved because the foundry was made cleaner and more orderly.

No two foundry mechanization problems are alike. That's why it will pay you to take advantage of Link-Belt's broad experience and equipment in laying out a system for handling sand and castings best suited to your requirements. Call your Link-Belt office today or write for Book 2423.

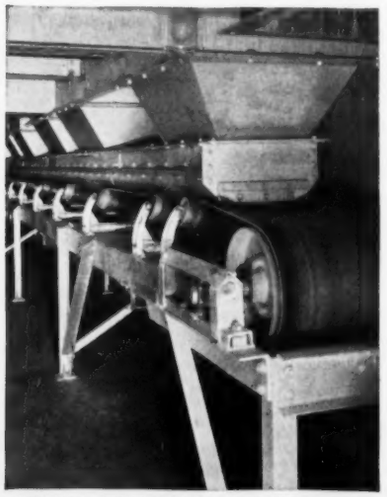
LINK-BELT

CONVEYORS AND PREPARATION EQUIPMENT



DISTRIBUTING BELT CONVEYOR delivers prepared sand to molding stations directly below. System is designed to handle approximately 40 tons per hour of prepared sand for production of brass and aluminum castings.

PADDLE MIXER combines water with shakeout sand from storage bin producing a uniform molding sand. Link-Belt makes single- and double-shaft mixers in a range of capacities.



TRANSFER BELT CONVEYOR under floor receives shakeout sand through grates and transfers it to bucket elevator. Conveyors can be equipped with magnetic devices to remove ferrous metal particles.

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

MEMBER FEMA

14.822

Circle No. 129, Page 7-8

through to completion. All steps are interlocked; stoppage of one step stops the entire machine. Main lifting, lowering, shuttling, and push-off operations are done by air cylinders.

No. 1 cylinder raises the weight frame into position over the sand-filled flask.

No. 2 lowers the weight on top of sand and holds it in position for the jolt action.

No. 3 and 6 perform shuttling operations; they move the cope mold unit into the center of the roll-over section. Two ram cylinders, built into the machine, move the roll-over clamp table down and clamp the cope mold unit. Roll-over cylinders turn over the cope mold unit for the vibrating cycle. The clamping table lowers to make the draw and the bottom board, cope mold and flask are drawn from the pattern.

Cylinders 7 and 8 push the flask, mold, and bottom board onto conveyor rollers. Cylinders 7 and 8 then retract and the roll-over table holding the empty cope patterns rolls back. At the completion of roll-over, the empty pattern is locked into the shuttle mechanism at the center of the roll-over section.

While cope mold operations are in progress, the drag operator has placed the drag flask on its pattern, dumped sand into the flask and pushed the drag-jolt-cycle control button. The same cycle of operations are performed as for the cope mold.

Cylinders 4 and 5, used in the drag cycle, duplicate steps of cylinders 1 and 2 in the cope sequence. *Flick-Reedy Corp.*

For Manufacturer's Information Circle No. 23, Page 7-8

Hot-topping compound for heating and insulating surface of risers in nonferrous castings is added on top of liquid metal after pouring. Exothermic compound heats surface of riser; delays freezing and formation of solid skin. When action is completed, the burned-out material has a strong insulating effect. *Foundry Services, Inc.*

For Manufacturer's Information Circle No. 24, Page 7-8

Core file or striker bar has tooth-like corrugations to give a filing surface, said to reduce physical labor, reduce cleaning time, and give longer life. Sizes range up from ½-in. square. *James H. Gaffney, Inc.*

For Manufacturer's Information Circle No. 25, Page 7-8

Epoxy resin dermatitis said to be reduced by using skin coating consisting of a plastic dispersed in gel form in a water base. Plastic film formed by evaporation is said impervious to epoxies, amines, and other harden-

Circle No. 130, Page 7-8

LIN·O·SET saves

MAKING 4-TON CORE AT WISCONSIN GREY IRON FOUNDRY COMPANY, MILWAUKEE

OLD METHOD
Pitch Core

Fabricating time . . . 18 hours
Baking time . . . . . 20 hours
Shake-out time . . . . 20 hours
TOTAL . . . . . 58 hours
. . . . 7¼ DAYS*

NEW METHOD
LIN·O·SET Core

Fabricating time . . . 8 hours
Baking time . . . . . 10 hours
Shake-out time . . . . 1½ hours
TOTAL . . . . . 19½ hours
. . . . 2 7/16 DAYS*

8,800 lb. LIN·O·SET core set in mold; took twenty-two 400 lb. loads of core sand. This core has 60% less rodding than previous pitch core.

*8-hour day

LINOIL CORE OIL · **INDUCTOL** FAST BAKING CORE OIL · **ADMIREZ** FOUNDRY RESIN · **LIN·O·SET** AIR-SETTING BINDER · **ADCOSIL** CO_2 BINDER · **FREFLO** PARTING COMPOUND

Archer·Daniels·Midland company
FOUNDRY PRODUCTS DIVISION · 2191 West 110th Street, Cleveland 2, Ohio

over 4¾ days...

The casting is a base for giant gear housing; weighs 12,780 lbs.

ARCHER QUALITY

There's an ADM Binder for

Every Process — Every Type Core — Every Type Sand

ers, glass fibers, polyesters, styrene oxide, and most organic solvents Attacked only by acetones and methyl and ethyl alcohols. Coating is water soluble and washed off without soap. *Milburn Co.*

For Manufacturer's Information Circle No. 26, Page 7-8

CO_2 sand mixer eliminates heating of sand by means of flexible, spring-steel arms to move sand against mixer walls where it is rubbed and squeezed. Action said not to heat or crush the sand. Used in making internal cores for semipermanent mold castings. Consistent sand mixes reported. Mixer occupies little floor space, can be moved by fork lift truck; requires no foundation. Discharge door 28 in. above floor accommodates 3 cu ft wheelbarrow. *Federal Foundry Supply Co.*

For Manufacturer's Information Circle No. 27, Page 7-8

Foundry shakeout handles molds up to 30 in. square and weights up to 500 lb. Load and shake-out are supported on soft springs. Unit is 13 in. high. Driven by ½-hp motor with direct drive coupling. Requires no foundation supports. *Hewitt-Robbins, Inc.*

For Manufacturer's Information Circle No. 28, Page 7-8

Dust collector separates dust by centrifugal action with water providing wetting and trapping. During flow air is not reversed nor its movement disturbed by baffles or impediments. Sludge may be removed automatically or semi-automatically. *Dust Suppression & Engineering Co.*

For Manufacturer's Information Circle No. 29, Page 7-8

Gray Iron Design Contest Will Close on August 20

■ Cash prizes of $850 will be awarded to winners of the annual Gray Iron Founders' Society design contest.

Entries showing a design or redesign of a product using gray or ductile iron must be submitted before August 20. The contest is open to all persons engaged in the metalworking industry. Entries may be made individually or jointly. Judging will be done on how the design did or could increase the efficiency of the product; cost savings; the potential commercial importance to the gray iron industry; and ingenuity.

The first place winner will receive $500, second place, $100. Third through seventh place winners will receive $50 each. All other entries will receive a set of six G.I.F.S. manuals.

Circle No. 130, Page 7-8

Put Famous
CORNELL
CUPOLA FLUX
into your foundry operation

Don't accept substitutes

And if you do, be prepared for quality iron because Cornell Flux is a scientifically prepared mixture of high grade fluorspar and other materials which cause a chemical reaction in molten iron which gives greater tensiles. Metal is cleaner — sulphur is reduced.

Have you tried Famous Cornell Aluminum or Brass Flux?

Write for Bulletin 46-A.

FAMOUS CORNELL FLUXES
Trade Mark Registered

The* CLEVELAND FLUX *Company

1026-40 MAIN AVENUE, N.W. • CLEVELAND 13, OHIO

Manufacturers of Iron, Semi-Steel, Malleable, Brass, Bronze, Aluminum and Ladle Fluxes—Since 1918

Circle No. 131, Page 7-8

let's get personal

Malleable Founders' Society has announced the election of **P. C. DeBruyne,** Moline Malleable Iron Co., St. Charles, Ill., as president of the organization. **R. W. Crannell,** Lehigh, Inc., Easton, Pa., was elected vice-president, and **Roy Willison,** National Malleable and Steel Castings Co., Cleveland, was elected treasurer. **Lowell D. Ryan** was re-elected executive vice-president and secretary.

General Electric Foundry Department has announced three managerial appointments: **Joseph B. Stazinski** has been named manager of manufacturing for the firm's Elmira, N. Y., foundries, and **Martin J. O'Brien** has been named manager of manufacturing for the Everett-Lynn, Mass., foundries. **E. R. Filosi** has been appointed manager of manufacturing engineering for the Everett-Lynn plants.

Magnet Cove Barium Corp. has promoted three men to new posts as district managers of the industrial products department. Appointed were: **R. L. Snook,** southwestern district manager; **Gerry Morrical,** midwestern district manager; and **H. M. Gwyn, Jr.,** eastern district manager.

Wilson H. Moriarty . . National Malleable and Steel Castings Co., Cleveland, executive has been awarded the annual Charles H. McCrea award by the Malleable Founders' Society.

E. C. Zuppann . . formerly with Oliver Corp., South Bend, Ind., has joined Bendix Aviation Corp., Lake Shore Div., St. Joseph, Mich. Mr. Zuppann is a member of four AFS Sand Division technical committees.

R. D. Phelps, Jr. . . secretary of Francis & Nygreen Foundry Co., Chicago, has been awarded a testimonial plaque by Chicago Foundrymen's Association for his service to the group.

Texas Foundries, Inc., Lufkin, Tex., has announced a series of new appointments: **Vernon H. Patterson,** formerly New York manager of foundry sales for Climax Molybdenum Co., has been named sales manager; **Joe W. Beckham** has been promoted to head a new product development department; **Arthur P. Guidi** has been transferred to a new position as assistant plant manager; **Fred Jacobs** has been promoted to the new post of technical director.

Paul Leonard . . has been appointed to the sales staff of Advance Foundry Co., Dayton, Ohio. He was formerly traffic manager for the firm.

S. B. Donner . . has been named plant manager of Deemer Steel Casting Co., New Castle, Del. He was formerly chief manufacturing engineer and assistant foundry manager at Yale and Towne Mfg. Co.

H. M. Gwyn

R. L. Snook

G. Morrical

Charles A. Faist . . has been named chief metallurgist for Burnside Steel Foundry Co., Chicago. He was formerly research metallurgist for the firm.

Curtis C. Drake . . plant superintendent and sales representative, Griffin Wheel Co., Denver, Colo., and a national director of AFS, has announced his retirement. He will now act as a foundry consultant. Mr.

C. C. Drake

Drake started with Griffin Wheel Co. in 1916 and was named plant superintendent in 1939. He was named to his present position in 1941. He is a charter member of the AFS Timberline Chapter and is a member of many technical and engineering societies.

Charles F. Knuepfer . . has been appointed foundry manager for the foundry division of Fort Worth Steel and Machinery Co., Dallas, Tex. Mr. Knuepfer was formerly foundry superintendent and assistant works manager for Warren Foundry and Pipe Corp., Phillipsburg, N. J.

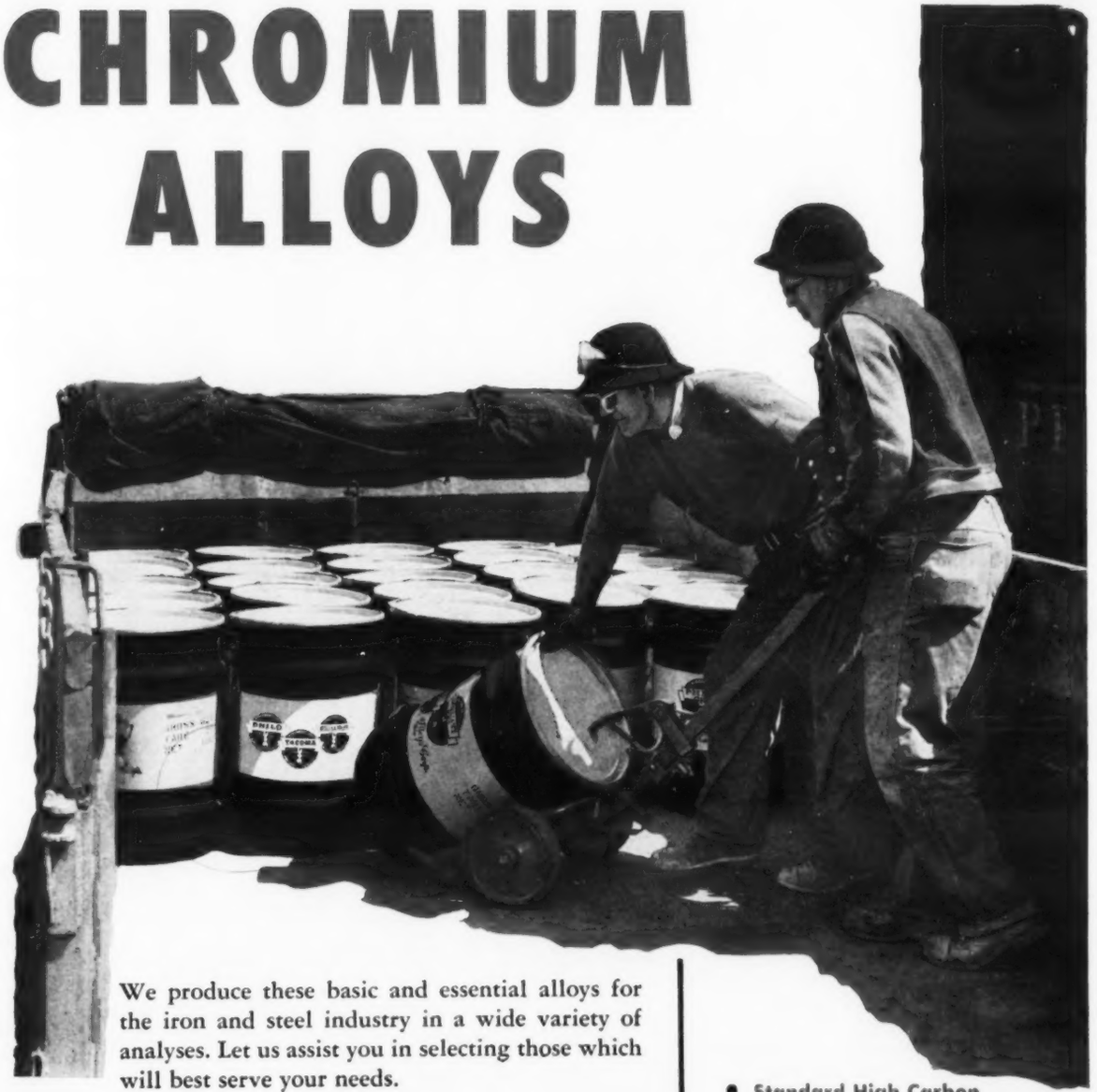
Frank B. Falvey . . has been appointed New York sales representative of American Manganese Steel Div., American Brake Shoe Co.

Arthur L. LaMasters . . former vice-president of Alloy Engineering and Casting Co. has joined Michigan Industries Co., Detroit, as vice-president in charge of sales.

John W. Coffey . . has joined Hansell-Elcock Co., Chicago. He was formerly associated with Gunite Foundries Corp., Rockford, Ill.

International Nickel Co., Inc., has named two scientists to the staff of its Bayonne, N. J., research laboratory. **R. D. Schelleng,** former holder of a research fellowship sponsored by AFS, has been named supervisor of the lab's ferrous castings section. Dr. Istvan Karsay has been named

CHROMIUM ALLOYS



We produce these basic and essential alloys for the iron and steel industry in a wide variety of analyses. Let us assist you in selecting those which will best serve your needs.

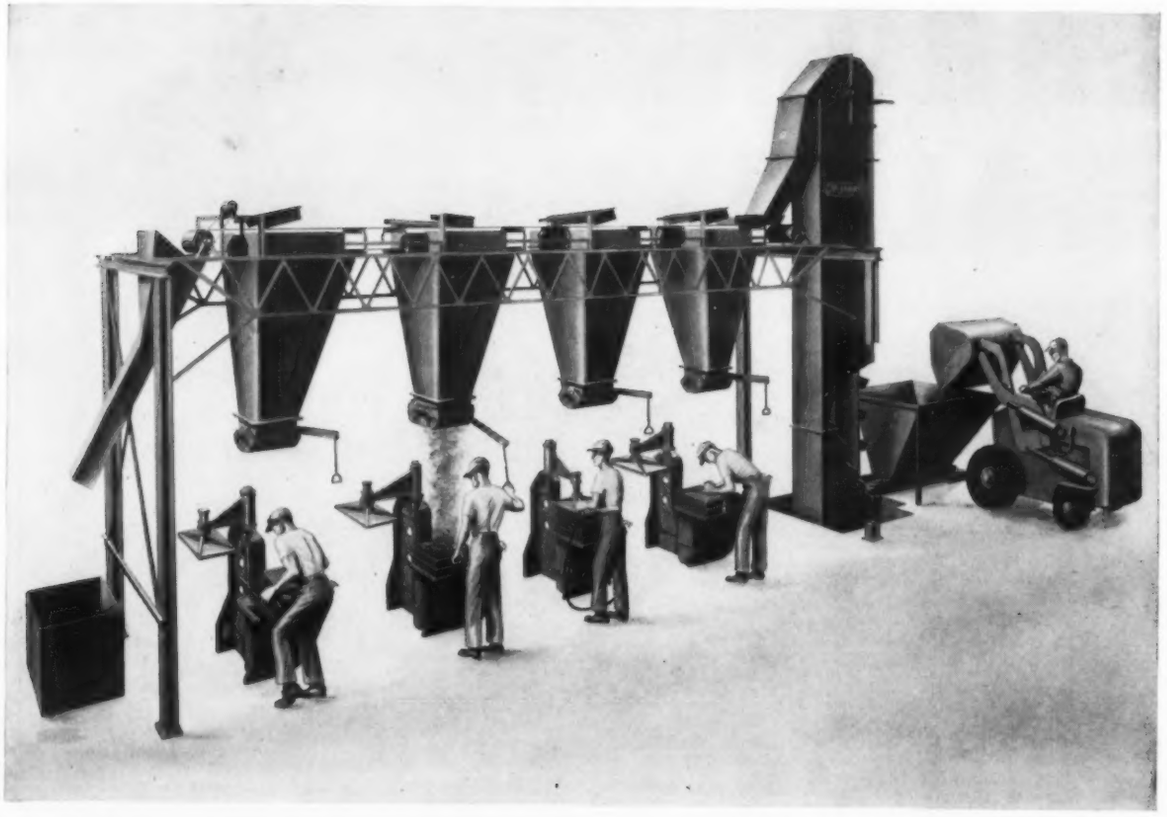
- Standard High Carbon Ferrochrome
- Low Chromium Ferrochrome
- Charge Chrome
- Low Carbon Ferrochrome
- Low Carbon Ferrochrome-Silicon
- Ferrosilicon-Chrome
- Foundry Grade Ferrochrome (High Carbon and Low Carbon Grades)
- Chromium Briquets

Ohio Ferro-Alloys Corporation
Canton, Ohio

SALES OFFICES

Birmingham, Chicago, Detroit, Los Angeles, Philadelphia, Pittsburgh, San Francisco, Seattle, Denver, Minneapolis

Circle No. 132, Page 7-8



Small foundries gain big foundry advantages with the **JEFFREY** Overhead Sand System

Available for 2, 4, 6 and 8 or more stations

EVEN with as few as two molding stations, you can economically install this Jeffrey overhead sand system. Molders' time is saved, their work made easier. No more having to lift the sand from the floor, because sand flows directly from overhead hoppers into the flasks.

Your molding costs are reduced, production is speeded up, workers are happier.

These Jeffrey overhead sand units were designed to meet the small foundry's need for low-cost equipment that gives it big-foundry advantages. Built as package units, savings made through reduced engineering and manufacturing costs are passed along to you. For detailed information, get in touch with The Jeffrey Manufacturing Company, 977 North Fourth Street, Columbus 16, Ohio.

HERE'S HOW IT WORKS

An LMV vibrating conveyor delivers conditioned sand from the hopper to the bucket elevator. It discharges sand directly into the hopper of a 2-station unit—onto the belt conveyor of larger units—from which plows divert it into the hoppers. Thus sand is always available on the molding line.

CONVEYING • PROCESSING • MINING EQUIPMENT . . . TRANSMISSION MACHINERY . . . CONTRACT MANUFACTURING

JEFFREY

Circle No. 133, Page 7-8

a research metallurgist in this section.

W. A. Luli . . has been named works manager in full charge of the Cooper-Bessemer Corp.'s Grove City, Pa. plant.

W. R. Wetzel . . has joined the sales department of Macklin Co., Jackson, Mich. Mr. Wetzel was formerly with Kelsey-Hayes Wheel Co. and LaPointe Machine Tool Co.

L. R. May . . former general manager of Cast Master, Inc., has been named vice-president and general manager of B & T Machinery Co., Holland, Mich., die casting equipment producer.

G. L. Knudson . . has been named midwest representative for Gerotor May Corp., Owings Mills, Md. He will headquarter in Chicago.

Norton Co., Worcester, Mass. has announced a series of staff changes that move **W. F. Winemiller** to manager of sales engineering in the Refractories Div., while **G. H. Powers** becomes assistant sales manager of the division. New production manager for the company's Abrasive Div. is **P. L. Lantz** who succeeds the late G. A. Fryberg.

E. W. Sniffen . . has been named district sales representative for Molybdenum Corp. of America. Mr. Sniffen will headquarter in Chicago.

Central Foundry Division, General Motors Corp., has announced a series of staff changes at the Saginaw Malleable Iron Plant, Saginaw, Mich. **Joseph F. Orloff** has been promoted to the new position of general superintendent and **Arthur J. Karam** has been promoted to the new post of production manager. Other changes are: **Robert W. Leppien,** now manufacturing superintendent; **William B. Goodrich,** now superintendent-finishing; **Steve Spess,** now superintendent-production control; **Francis B. Howard,** now superintendent-foundry; **Ralph F. Mesack,** now superintendent-standards and methods.

D. V. Ragone . . assistant professor of metallurgical engineering, University of Michigan, has been named the year's Outstanding Young Engineer by the Engineering Society of Detroit. Dr. Ragone has authored a number of technical papers for presentation to AFS.

American Die Casting Institute, Inc., New York, has named **David Laine** as secretary replacing **W. J. Parker.**

Mr. Parker is now treasurer of the organization.

Charles C. Jarchow . . president and a director of American Steel Foundries, Chicago, has been elected to the board of Universal Oil Products Co., Des Plaines, Ill.

Eugene F. Schlickman . . director of industrial relations research for National Foundry Association, Chicago, has been sworn in as a member of the Illinois bar.

J. R. Welsh . . has been appointed assistant general purchasing agent of American Brake Shoe Co., New York. He was formerly purchasing agent for ferrous materials.

J. F. B. Jackson . . deputy managing director of A.P.V.-Paramount Ltd., English alloy steel foundry, has joined the board of P.I. Castings (Altrincham) Ltd.

E. W. Burne . . has been named manager of the newly created employee and plant community relations section of General Electric Co.'s Foundry Department, Schenectady.

Joseph L. Miller . . has been appointed general traffic manager of Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

Central Foundry Co., Newark, N. J., has elected **James K. Norris** as president and **J. P. Singleton** as vice-president. Mr. Norris was formerly board chairman of Utica Drop Forge & Tool Co. Mr. Singleton was previously manager of the Central Foundry plant at Holt, Ala.

Beardsley and Piper, Division of Pettibone Mulliken Corp., has announced three personnel changes among its sales representatives: **A. L. Miller,** sales engineer, has retired after 40 years in the castings industry; **Warren Fraser** has been appointed a sales representative with headquarters in Atlanta, Ga.; **Alexander Weston,** 30-year veteran in the castings industry, has also joined the firm as a sales representative.

Richard A. Szara . . has been appointed a sales representative in the Chicago office of Archer-Daniels-Midland Co. Foundry Products Division.

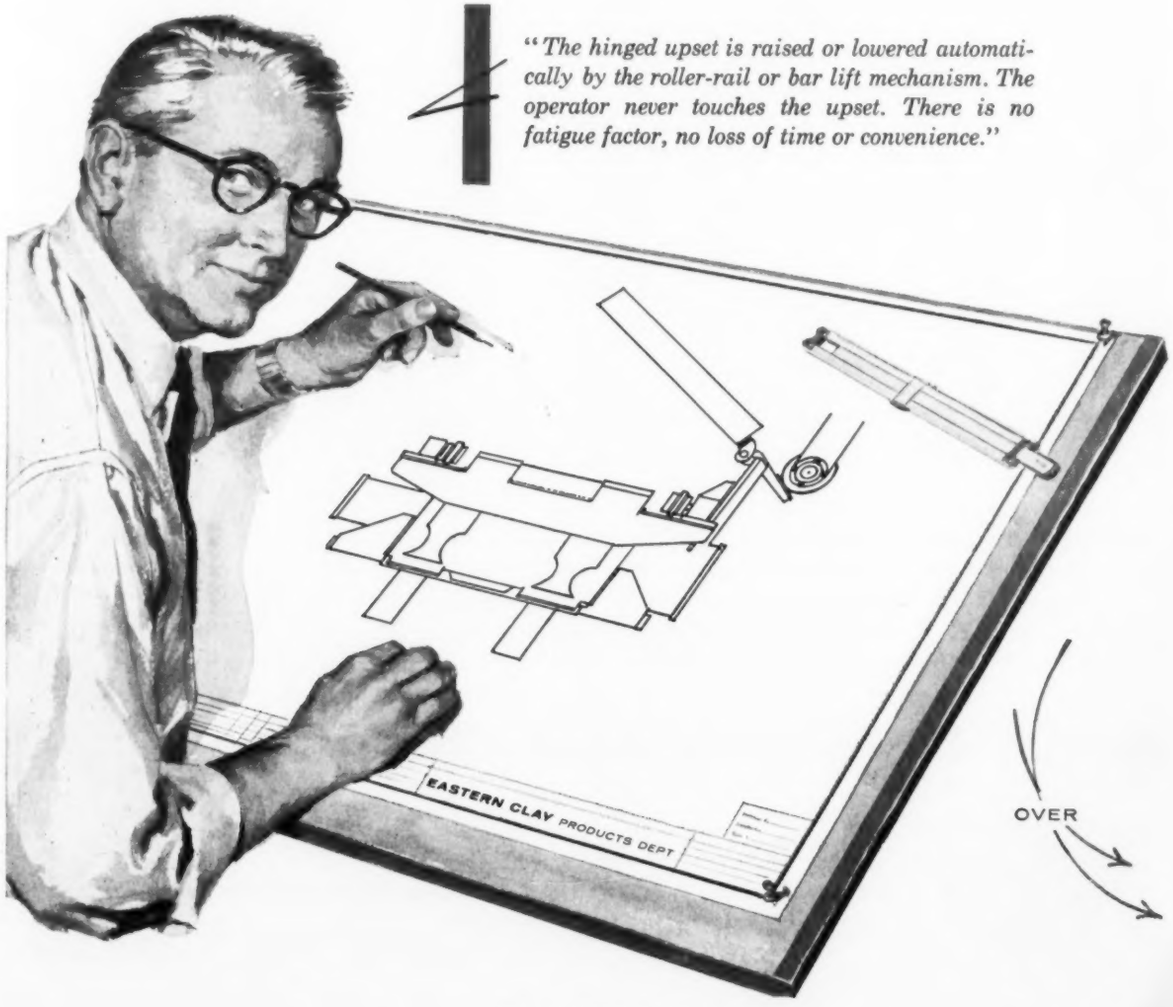
William R. Oakley . . has been named vice-president of Delhi Foundry Sand Co., Cincinnati. He has been associated with the firm since 1954 and is a director of the AFS Cincinnati District Chapter.

You Can Use

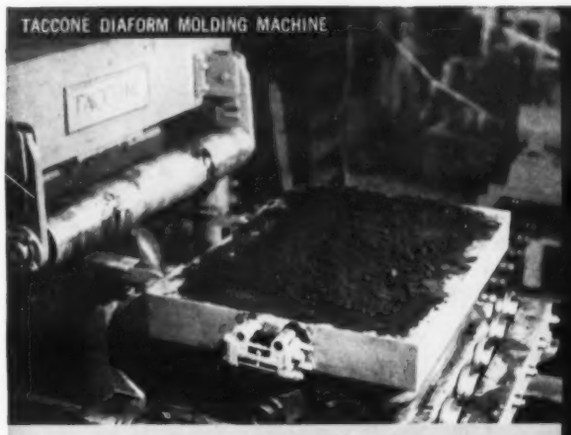
Light, Shallow and Regular Flasks with High Pressure Diaform Squeeze

Now, by installing the new automatic power-driven upset strike-off, you can use existing flask equipment with the Taccone Diaform Molding Machine. This new auxiliary mechanism enables you to adopt high pressure diaform squeeze at minimum cost . . . and quickly get the economies, speed of operation and precision casting performance that are possible with the high pressure process.

"The hinged upset is raised or lowered automatically by the roller-rail or bar lift mechanism. The operator never touches the upset. There is no fatigue factor, no loss of time or convenience."



Circle No. 134, Page 7-8



1 The power-driven hinged upset takes all the outward thrust exerted by the diaphragm. Therefore, even with the high pressures involved, flask distortion is always at a minimum even with light flask equipment.

2 The hinged upset lifts automatically to clear the mold for either manual or automatic strike-off. This operation takes place during the stripping cycle so there is no lost time or motion. The upset is drafted to insure a clean strip.

3 The power-driven strike-off can be mounted in any convenient position, either beside the molding machine or on the relief conveyor. The mold may be pushed through manually or by a simple pneumatic pusher or indexing device.

4 The strike-off gives you a flat mold for convenience in setting on conveyors or floor, or for setting weights. The flat cope and drag eliminates the need for increased flask depth and extra heavy construction.

We would welcome an opportunity to explain this new upset strike-off mechanism in greater detail. Simply write for your copy of the complete portfolio on High Pressure Molding. It will show you how, with the Taccone Diaform Molding Machine, you can get greater speed, improved finish of castings, reduced casting weight and lower maintenance . . . which all add up to greater profit.

Write for copy of booklet **"TACCONE DIAFORM MOLDING MACHINES"**

EASTERN CLAY PRODUCTS DEPT.
INTERNATIONAL MINERALS & CHEMICAL CORPORATION
20 NORTH WACKER DRIVE, CHICAGO 6 • PHONE: Financial 6-1800

Circle No. 134, Page 7-8

Missouri Valley Regional to be Held in September

■ Simultaneous sessions on gray iron, non-ferrous, and steel will be conducted at the two-day Missouri Valley Regional Conference of the American Foundrymen's Society to be held September 28-29 at the Missouri School of Mines & Metallurgy, Rolla, Mo.

The conference will be sponsored by the St. Louis, Mo-Kan, Tri-State and M.S.M. Student Chapters of AFS. Robert W. Trimble, Bethlehem Supply Corp., Tulsa, Okla., will be the conference chairman.

Friday at 10 am Dean Curtis L. Wilson, Missouri Schol of Mines & Metallurgy, will welcome the found-

Robert W. Trimble

rymen. AFS President Harry W. Dietert will dicsuss *"The American Foundrymen's Society and Foundry Progress,"* and Charles E. Drury, Central Foundry Div., GMC, Danville, Ill. will speak on *"Gating to Control Pouring Rate and its Effect on Castings."*

The technical program:

FRIDAY, SEPTEMBER 28

Gray iron—Presiding, Charles Ossenfort, Fairbanks, Morse & Co., Kansas City, Kan.

2:10 pm . . *"Inoculation & Alloying Agents for Gray Cast Iron,"* Howard H. Wilder, Vanadium Corp. of America, Chicago.

3:15 pm . . *"Melting, Molding & Men,"* Harry H. Kessler, Sorbo Mat Process Engineers, St. Louis.

Non-ferrous—Presiding, Ivan Morrow, Morrow Pattern Shop & Foundry, Inc., Coffeyville, Kan.

2:10 pm . . *"What's New Among Non-Ferrous Foundrymen?"* Herbert F. Scobie, Non-Ferrous Founders' Society, Evanston, Ill.

3:15 pm . . *"Production of Qual-*

ity Aluminum Castings," Charles Maxwell, Howard Foundries, Chicago.

Steel—Presiding, James Cannon, Duncan Foundry & Machine Works, Alton, Ill.

2:10 pm . . *"Designing Valves for Sound Castings,"* Arnold S. Grot, Edwards Valves, Inc., East Chicago, Ill.

3:15 pm . . *"Unionarc Welding as Applied to the Foundry Industry,"* H. T. Smith, Linde Air Products Co., St. Louis.

SATURDAY, SEPTEMBER 29

Gray iron — Presiding, Norman L. Peukert, Carondelet Foundry Co., St. Louis.

9:10 am . . *"Molding Sands, Molding Methods & Casting Dimensions,"* J. S. Schumacher, Hill & Griffith Co., Cincinnati.

10:15 am . . *"Casting Defects,"* William A. Hambley, Chas. A. Krause Milling Co., Milwaukee.

Non-Ferrous—Presiding, H. P. Swickrath, Prier Brass Mfg. Co., Kansas City, Mo.

9:10 am . . *"Permanent Molding of Aluminum Castings,"* C. B. Curtis, Maytag Co., Newton, Iowa.

10:15 am . . *"The Pros and Cons of Centrifugal Castings,"* M. E. Nevins, Wisconsin Centrifugal Foundry, Inc., Waukesha, Wis.

Steel—Presiding, Edward W. O'Brien, Oklahoma Steel Castings Co., Tulsa, Okla.

9:10 am . . *"The Arc-Air Process,"* M. D. Stepath, Arc-Air Co., Lancaster, Ohio.

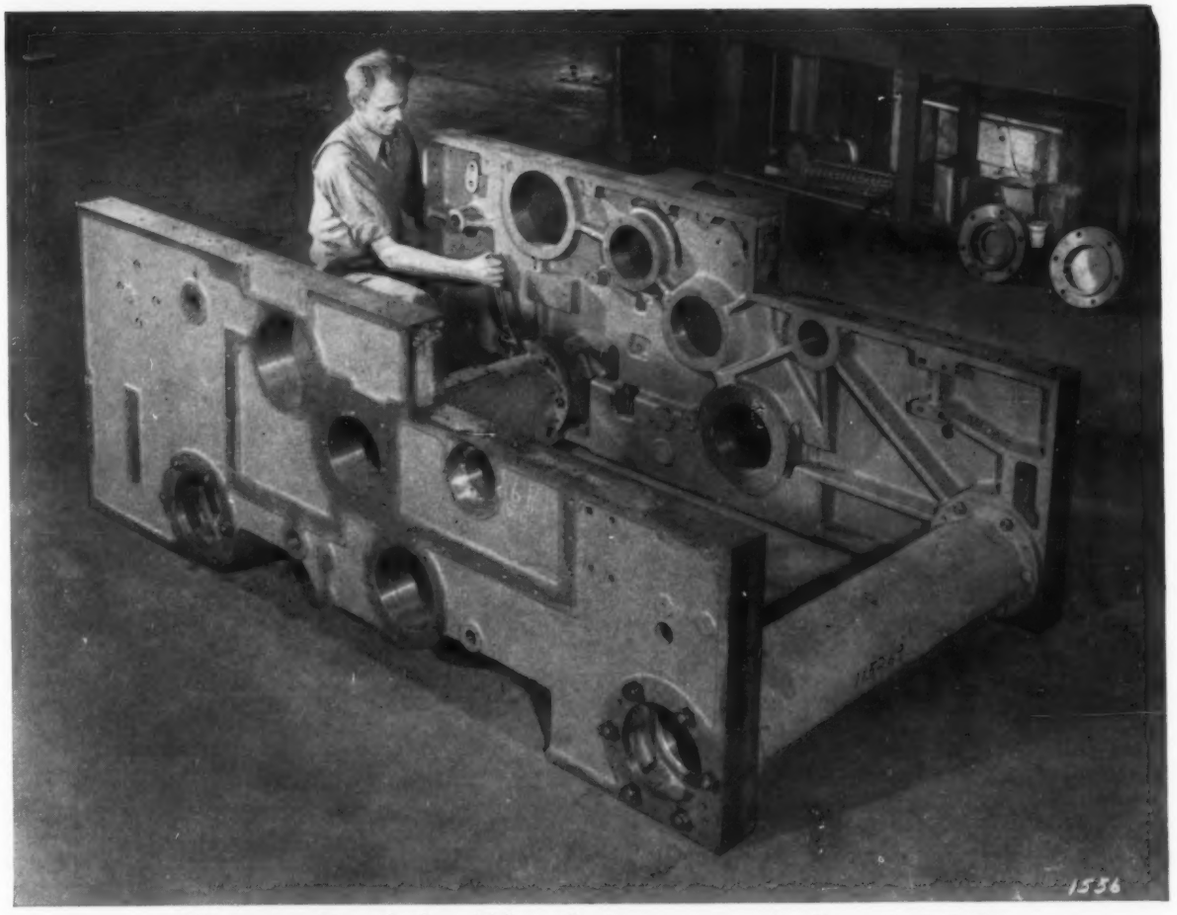
10:15 am . . *"Where To? CO_2 Cores for Steel Castings,"* James Venetucci, Liquid Carbonic Corp., Chicago.

Sessions will be adjourned at noon.

Room reservations should be addressed to Missouri Valley Regional Conference, room 102, Parker Hall, Missouri School of Mines & Metallurgy, Rolla, Mo.

P. B. Craighead Elected Head of Magnesium Group

■ Philip B. Craighead, Magnesium Products, Milwaukee, was elected president of The Magnesium Association at its annual meeting held in June at Hot Springs, Va. Otis E. Grant, Magnode Products, Inc., Trenton, Ohio, and John Thomson, Dominion Magnesium, Ltd., Toronto, Canada, were elected vice-presidents.



1300 pound cast frame for large high speed bag-making machine. L. Brayton Foundry Co. uses a 1% nickel cast iron for frames to assure accurate alignment of shafts and cross members during assembly by St. Regis Paper Company, East Providence.

How nickel irons help you maintain control of large, complex castings

One of the easiest ways to obtain dimensional stability in a big, intricate casting is to use a nickel cast iron.

Take the matched frame members shown above, for example.

You'll see the problem right away. Unless cored holes and to-be-machined surfaces line up almost perfectly . . . up go machining costs.

Now notice the heavy bosses and ribs. And take note that the supporting web is ½-inch thin. You would expect some chill in this web and a tendency to warp. And you might forecast a costly stress relief or expensive set-up time in machining operations.

L. Brayton Foundry got around all this quite easily. By using a nickel cast iron mix, they were able to deliver these frames "as cast" and meet all requirements for dimensional accuracy.

Nickel irons give you more control over chill...help keep warping stresses low

Nickel cast irons show less tendency to chill. With these irons, structure is more uniform. Build-up of internal warping stresses in large, complex castings is not as high.

What's more, selection of the right grade of nickel iron gives you improved control over structure, and hence, machinability, wear resistance, strength and other properties desired by you and your customers.

Pass on to your customers the benefits of nickel cast irons

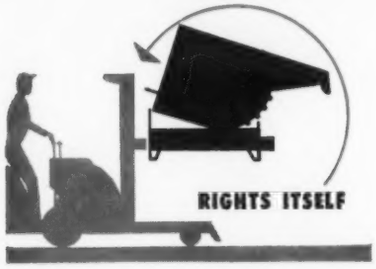
Next time you have an order coming up for a large, complex casting, look into the economics of nickel cast irons. You may be able (1) to reduce your own costs or (2) to provide your customer with a much better casting.

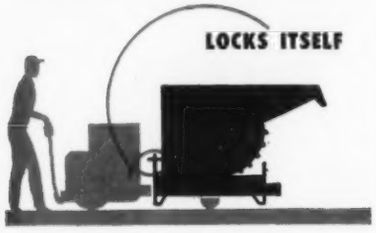
Maybe you can do both. The way to find out is to contact Inco. Inco's engineering service can help you . . . on either a special foundry problem or to help convince a customer.

THE INTERNATIONAL NICKEL CO., INC.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK

NICKEL CAST IRONS...*best for you because they're best for your customers*





Cuts hand unloading

costs 50% or more

Figure it out yourself. Compare the cost of this one-man semi-automatic operation with the time and labor involved in hand-unloading. The answer is obvious. Hundreds of leading industries have proved it . . . and are using thousands of Roura Self-Dumping Hoppers for handling wet or dry, hot or cold bulky materials.

Roura builds 'em rugged. They're made of extra heavy gauge metal with sturdy welded joints to stand up under the terrific knocks and bangs of rough handling. Fit any standard fork or platform lift truck. Also available mounted on live skids—casters with malleable or rubber tired wheels. Sizes from ½ to 2 cubic yards.

Let Roura help *you* cut costs.

ROURA
Self-Dumping
HOPPER

WANT MORE FACTS?
We'll give you full details . . . without obligation . . . if you'll attach this coupon to your letterhead . . . sign your name . . . and mail to . . .

ROURA IRON WORKS, INC.
1414 Woodland Ave., Detroit 11, Michigan

Circle No. 135, Page 7-8

the editor's field report

by Jack Schaum

◗ **The Croning Process:** The Croning process was developed and patented in 1944 by Johannes C. A. Croning in Germany. For this outstanding contribution to the foundry industry Mr. Croning was awarded the John A. Penton Gold Medal at the 61st AFS Castings Congress, May 8, 1957. With sincere regret the July issue of MODERN CASTINGS carried the announcement of Croning's death on May 16. The Croning process, which later came to be known as the shell molding process, was introduced in the United States shortly after the close of World War II. This new process found its mark in the mass production casting needs of American industry.

Shell molding has led to the establishment of an entirely new equipment industry, has created new markets for the plastics industry, and set new standards of quality for cast metals.

We usually think of shell molding as a more expensive process than green sand molding for producing castings. Consequently the price of the castings must be higher. The customer is willing to pay the higher price because of subsequent savings in other costs such as machining.

Foundries using shell molding equipment are now finding more jobs where they can compete with green sand despite the fact that the casting does not require a quality finish. The inherent advantages of a mechanical operation with minimum labor requirements are paying-off. Elimination of flask handling and reduction in the amount of sand needed per mold are plus factors leading to lower costs. Central Foundry Division, GMC, is now casting four camshafts in a single shell mold weighing only 18 lb compared with 380 lb green sand mold it replaced. Another foundry is pouring four pounds of metal into a shell mold weighing only one pound!

Die casters are also feeling the competition of shell molders. Die castings are limited as to the number of cavities that can be put in one die and by the fact that only one die can be filled at a time on the machine. Dies cost considerably more and have a shorter productive life than the metal patterns used in shell molding. By using multi-cavity shell molds and stack molding techniques there is practically no limit to the number of castings that can be poured at one time when using shell molds.

◗ **Old Foundries:** Several months ago, April to be exact, MODERN CASTINGS printed a card on page 7 asking old foundries to tell us when they started in business. Judging from the overwhelming lack of response to this query I would guess that foundries are as reluctant as most women to reveal their age. However two foundries have established a mark for the rest of you to shoot at.

According to James Lanning, president, of the very appropriately named Preservance Iron Foundry in Philadelphia, they are celebrating their 100th anniversity in 1957. One of their prize possessions is a cupola that has been operating for 72 years. Interesting products of their past production included 3-legged French kettles used by the Indians in the southwest United States.

Top honors go to the Gray Foundry, Inc., Poultney, Vermont, where iron was melted in 1828. According to an interesting letter from Norman G. Knapp, President and General Manager, the company holds patent No. 42, "Improvement in Stoves", signed by James Buchanan, Secretary of Interior.

Industrial history is reflected in the nature of castings produced in their foundry. In 1845 castings were being made for horse-driven tread mills and grain threshers; in 1862 curry combs were made for the Federal Cavalry; by 1868 they were building slate-working machinery for local slate quarries; a broaching machine was developed in 1870 for making slate pencils; their first gas combustion engine for farm use was built in 1899; stone saws and planers were big production items in the early 1900's; a slate and soapstone boom in the 1920's kept the foundry busy; production was for the military during both World Wars; and today the foundry supplies castings for machine tools, textile and paper machinery, and pipe bending.

During this period the Gray Foundry has risen from the ashes of two fires and has had the waters of two floods four feet deep on the main foundry floor.

If this plunge into the past arouses any nostalgic memories among you foundrymen why not drop me a line about the "good old days" you remember or heard about in your foundry operations.

Noah A. Kahn Dies at 63

Noah A. Kahn, head metallurgist of the Material Laboratory, New York Naval Shipyard, Brooklyn, N.Y., died suddenly June 20, while attending the American Society for Testing Materials' Convention in Atlantic City. He was 63 years old.

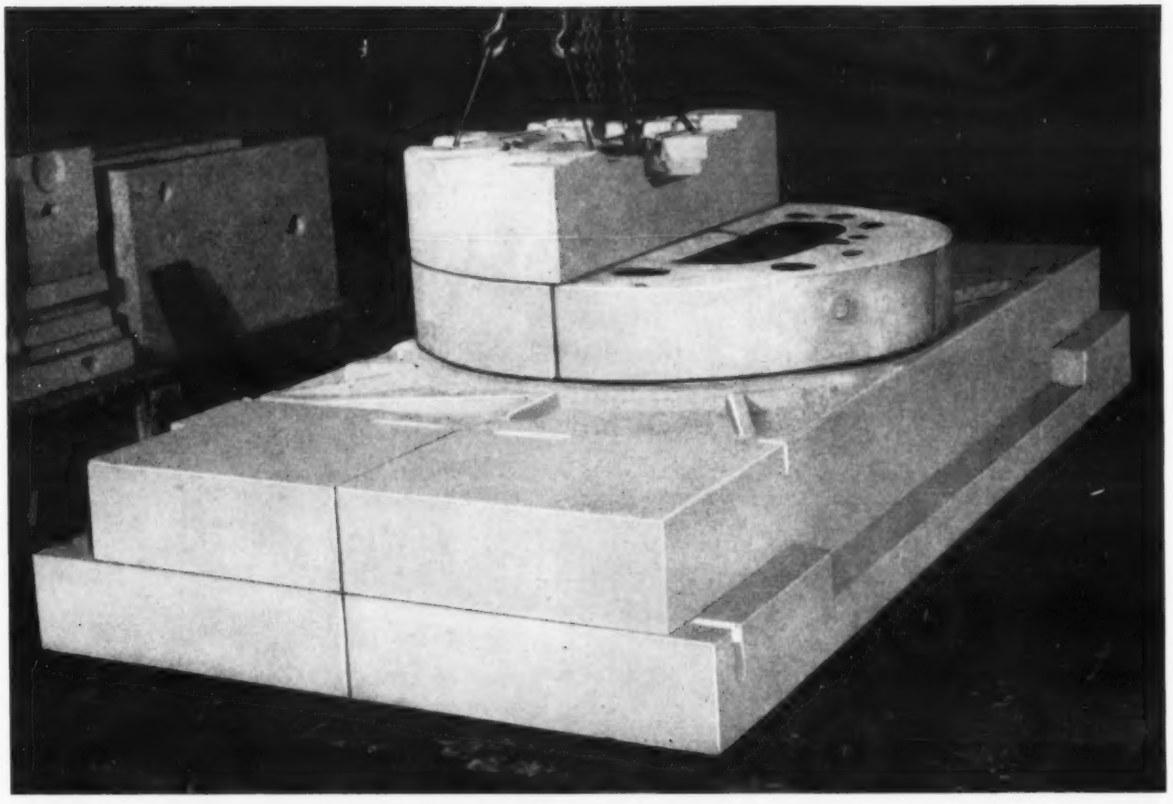
Mr. Kahn graduated in Chemical Engineering from Lehigh University in 1922. After four years as research metallurgist with Bethlehem Steel Co. he completed post-graduate work at Washington University, receiving an M.S. Degree in 1927. Since that time he has been associated with New York Naval Shipyard, receiving the

Meritorious Civilian Award in 1944 for distinguished service to the Navy.

An active member of American Foundrymen's Society, serving on the Recommended Practices for Nonferrous Alloys Committee and Inspection and Production Control Methods Subcommittee, Mr. Kahn also held membership in the Society for Nondestructive Testing, of which he was a charter member, American Society for Metals, Metal Science Club, American Society for Testing Materials, Scientific Research Society of America, and National Association of Naval Technical Supervisors. He was author of numerous technical papers and a frequent speaker before technical groups. In recognition of his achievements as engineer and scientist he is listed in *American Men of Science*.

Charles M. Vizzini, sales engineer, Specialty Products Co., Jersey City, N. J., died June 28. He was a member of the Metropolitan Chapter of AFS.

Robert M. Pitz, vice president and assistant general manager of Pitz Foundry, Inc., Brooklyn, N. Y., died April 4 as the result of an automobile accident. He was 30 years of age and was the third generation of the family to become an officer of the company.



How to pick the WINNING COMBINATION of Core Binders

Did you ever stop to consider that a core can go wrong in any of *twenty different ways?* Use the winning combination of such performance-proved binders as Dexocor, Mogul, Kordek and Globe Dextrines—and you'll get top performance all the way.

These famous binders have been developed to complement each other. Regardless of the size and complexity or simplicity of your casting, the metal you're running, your core making and casting facilities, there's a winning combination of binders that will give you best results . . . top quality castings, produced economically and fast.

Help in formulating this winning combination to meet your specific needs is available for the asking. Experienced men on our foundry staff will gladly work with you—no cost or obligation.

WINNING COMBINATIONS

For Outstanding Performance on:	Use This Combination of Binders:
Green bond	Mogul plus Dexocor
Dry bond	Dexocor plus Kordek
Green sand	Mogul plus Dextrine or Dexocor
Dry sand	Kordek plus Dexocor
Flowability	Dextrine or Kordek
Moisture resistance	Dexocor
Collapsibility	Dexocor plus Dextrine • Kordek or Mogul
Scratch hardness	Dexocor plus Dextrine or Kordek
Reduced baking time	Dexocor
Reduced gas	Dexocor
Better blowing	Dexocor plus Mogul
Easy ramming	Dexocor plus Mogul
Simplified, cleaner mixing	Dexocor
Easy shake-out	Dexocor • Mogul • Kordek or Dextrine
Reduced veining	Dexocor
Smoother casting finish	Dexocor
Dry, easily handled	Dexocor • Mogul • Kordek or Dextrine
Less waste in handling	Dexocor • Mogul • Kordek or Dextrine
Better core paste	Kordek
Reduced costs	Dexocor plus Mogul

CORN PRODUCTS SALES COMPANY
17 Battery Place, New York 4, N. Y.

Makers of DEXOCOR® · MOGUL® · KORDEK® · GLOBE® Dextrines

Circle No. 136, Page 7-8

Technical Sessions at '58 AFS Castings Congress Scheduled Tentatively

■ The tentative schedule for technical sessions at the American Foundrymen's Society 62d Castings Congress in Cleveland has been announced by the AFS Technical Council.

The 5-day program, May 19-23, includes technical sessions, author breakfasts, luncheons, shop courses, and Society meetings.

Each day's program will start with an authors breakfast to acquaint session chairmen, speakers, and the AFS staff. The breakfasts will be conducted by AFS Technical Director S. C. Massari. The day's activities will be explained and final arrangements made for equipment and material necessary to conduct the program.

Sessions will start at 9:00 am daily with evening activities scheduled for four nights. Two dinners and the annual AFS Banquet have been set for 6:00 pm. In addition, three evening shop courses will be held.

A total of five shop courses will be conducted, two by the Malleable Division and one each by Sand, Gray Iron, and Brass & Bronze.

Sand Division activities will be conducted on each of the five days. Malleable Division sessions will be held Monday and Tuesday. Steel Division meetings have been set for Monday and Tuesday and Gray Iron meetings for the final three days.

Other division and general interest committee meetings are: Pattern, Monday and Tuesday; Fundamental Papers, Monday and Tuesday; Light Metals, Tuesday, Wednesday and Thursday; Safety, Hygiene, and Air Pollution, Tuesday; Brass & Bronze, Thursday and Friday; Heat Transfer, Thursday and Friday; Industrial Engineering, Thursday and Friday; and Education, Thursday.

AFS activities include the Board of Directors Luncheon and Canadian Dinner on Tuesday; the Annual Business Meeting, Hoyt Lecture, Management Luncheon, and Annual Banquet on Wednesday; the Past Presidents Luncheon and Alumni Dinner on Thursday.

MONDAY, MAY 19

Morning....	Authors Breakfast. Pattern, Steel, and Malleable Sessions.
Noon.....	Steel Luncheon.
Afternoon...	Sand, Pattern, Malleable, and Fundamental Papers Sessions.
Evening....	Malleable Shop Course.

not twice...

not three times...

BUT OVER FIVE TIMES

THE PRODUCTION

and better quality too!

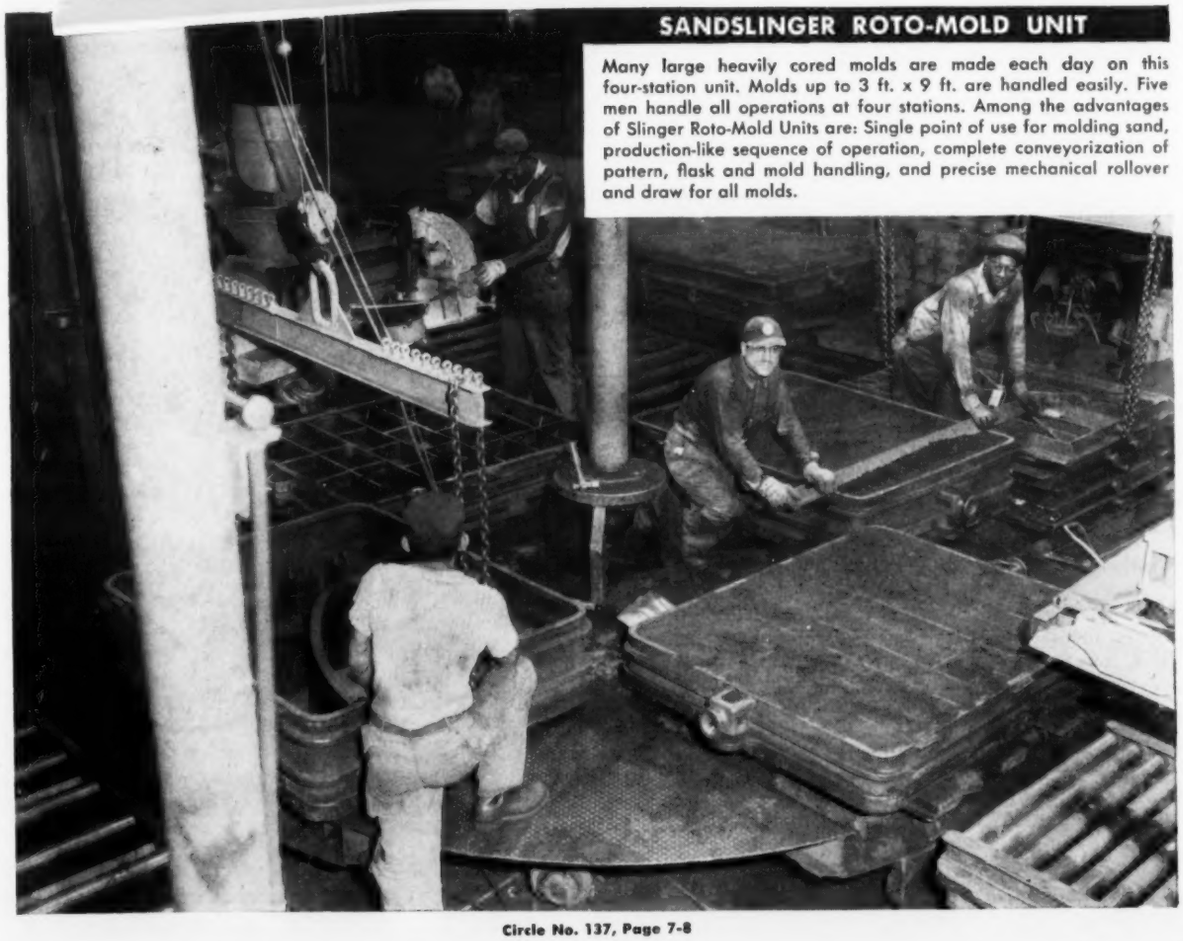
THE AMERICAN MFG. CO. OF TEXAS AT FORT WORTH, manufacturer of an outstanding line of oil field equipment, have recently increased the production of their gray iron foundry by over 500 per cent in virtually the same foundry area. They have done the job by applying production methods to their jobbing work. Their larger castings — weighing from 200 lbs. to a ton — are poured in molds produced on a new Slinger Roto-Mold Unit. This four-station unit permits the foundry to gain all of the production and quality advantages of production methods, while retaining the flexibility which is essential for their work. Fifty different jobs are regularly handled on the unit and six or eight pattern changes are made each day.

Sand for this operation, as well as for all other molding in the foundry, is fully mulled by a Model "60" Speedmullor. This single mullor thoroughly prepares over 200 tons of closely controlled synthetic sand each day. The mullor, equipped with Speedmullor Cooling and Mulltrolmatic Automatic Controls, delivers a fully aerated, cool, fluffy, flowable molding sand for the foundry's molding operations. Slinger ramming and Speedmullor mulling are primarily responsible for the fivefold increased production with increased quality at this recently modernized foundry.

Send for your copy of the BETTER METHODS story featuring the American Mfg. Co. of Texas. Beardsley & Piper, Div. Pettibone Mulliken Corp., 2424 N. Cicero Avenue, Chicago 39, Illinois.

SANDSLINGER ROTO-MOLD UNIT

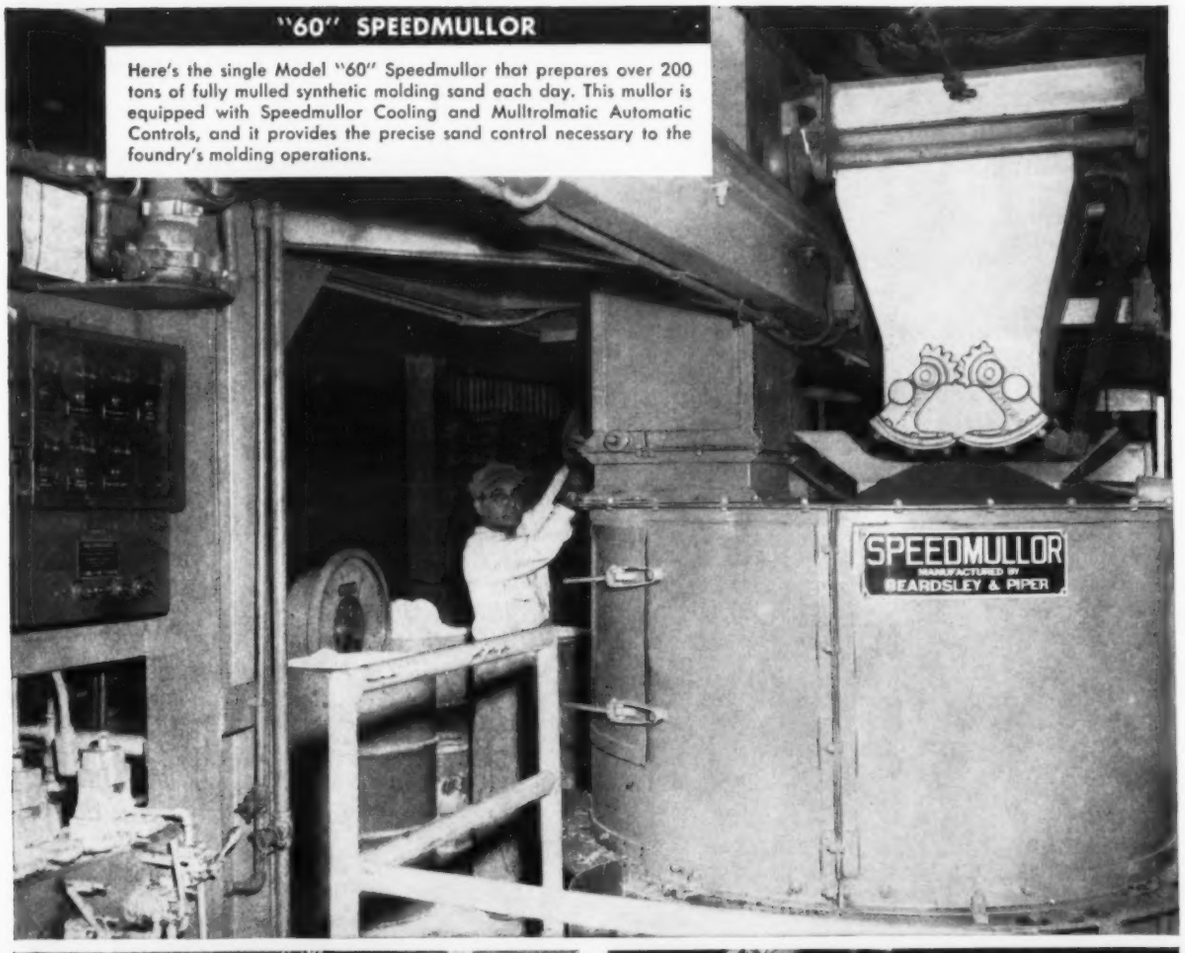
Many large heavily cored molds are made each day on this four-station unit. Molds up to 3 ft. x 9 ft. are handled easily. Five men handle all operations at four stations. Among the advantages of Slinger Roto-Mold Units are: Single point of use for molding sand, production-like sequence of operation, complete conveyorization of pattern, flask and mold handling, and precise mechanical rollover and draw for all molds.

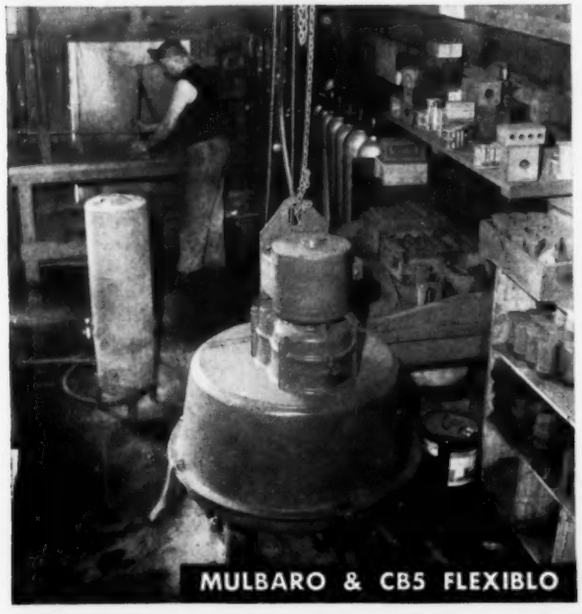


Circle No. 137, Page 7-8

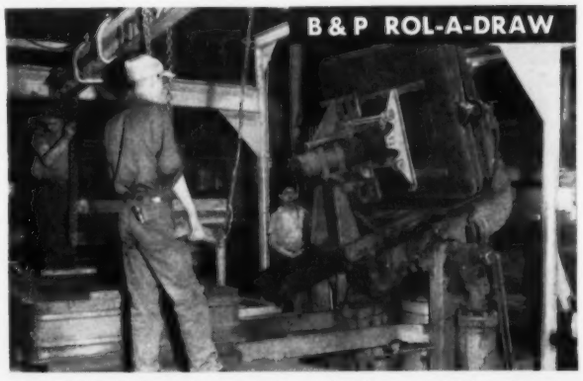
"60" SPEEDMULLOR

Here's the single Model "60" Speedmullor that prepares over 200 tons of fully mulled synthetic molding sand each day. This mullor is equipped with Speedmullor Cooling and Mulltrolmatic Automatic Controls, and it provides the precise sand control necessary to the foundry's molding operations.

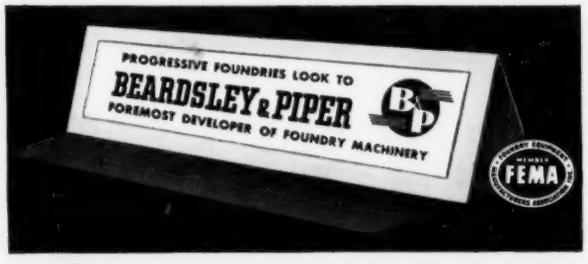




This B & P Model 3½ Mulbaro, formerly used to mull facing sand is now used to accurately and thoroughly mull a special CO^2 core sand mixture. The CO^2 sand is used in a CB5 Flexiblo Coreblower, seen in the background.



This 1020 RCX Rol-A-Draw rated at 3,000 lbs. capacity handles over 4,000 lbs. on some of the big Slinger Roto-Mold jobs. The machine provides a precise mechanical draw with a very fast cycle.



Circle No. 137, Page 7-8

TUESDAY, MAY 20

Morning....Authors Breakfast. Pattern and Light Metals Sessions.
Noon.....Luncheons: Malleable, Pattern, and Board of Directors.
Afternoon...Fundamental Papers, Light Metals, and Sand Sessions. Malleable Shop Course.
Evening....Dinners: Canadian and Sand. Sand Shop Course.

WEDNESDAY, MAY 21

Morning....Authors Breakfast. Annual Business Meeting. Hoyt Lecture.
Noon.....Management Luncheon.
Afternoon...Education, Light Metals, Gray Iron, and Sand Sessions.
Evening....Annual Banquet.

THURSDAY, MAY 22

Morning....Authors Breakfast. Brass & Bronze, Gray Iron, and Heat Transfer Sessions.
Noon.....Luncheons: Light Metals and Past Presidents.
Afternoon...Brass & Bronze, Education, Industrial Engineering, Sand, and Light Metals Sessions.
Evening....Alumni Dinner and Gray Iron Shop Course.

FRIDAY, MAY 23

Morning....Authors Breakfast. Brass & Bronze Round-Table Breakfast. Gray Iron and Heat Transfer Sessions.
Noon.....Gray Iron Luncheon.
Afternoon...Gray Iron Shop Course. Brass & Bronze, Industrial Engineering, and Sand Sessions.

Improved Properties Found In High-strength Bronzes

■ Superston, high-strength bronze, achieves 90,000-110,000 psi tensile strength, 90,000 psi ultimate, with 30-35 per cent elongation. Developed by V. Stone & Co. Ltd., London, England, this family of alloys contains 10-15% Mn, 7-9% Al, 2-4% Fe, 1.5-5% Ni, and the balance Cu.

Hardness ranges from 160-250 Bhn and with heat treating the hardness is raised to 350 Bhn. The alloys maintain their strength at elevated temperatures.

Superston alloys can be cast in sand, shell, or semipermanent molds. Compared to aluminum bronze, the alloys have a lower melting temperature, greater fluidity, and reduced skin tenacity.

Licencees for this metal in the United States are American Brake Shoe Co. (National Bearing Division) and Ampco Metal, Inc.

Get out the bandages, Princess Wenatchee! Coach Keokuk tried to show our boy how to slide home but Junior helped him go all the way!

You have a real "player" all warmed up and ready to bat for you when you've signed up Keokuk Silvery Pig Iron. This "major league" form of silicon introduction for foundries and steel plants goes all out to hold costs down and quality up. Pig for pig . . . car for car, Keokuk uniformity never varies. Handle by magnet, charge by weight or count the pigs for equal accuracy. Aluminum producers . . . you'll be safe on every play with Keokuk Silicon Metal!

KEOKUK ELECTRO-METALS COMPANY
Keokuk, Iowa
Wenatchee Division, Wenatchee, Washington

KEOKUK SILVERY PIG IRON
SILICON METAL—OTHER FERROALLOYS

Keokuk Silvery Pig is available in 60 and 30 lb. pigs and 12½ lb. piglets in standard analysis or alloyed to your specifications. Silicon metal and ferro-silicon are supplied in standard sizes and analyses.

SALES AGENT: MILLER AND COMPANY
332 S. Michigan Ave., Chicago 4, Illinois
3504 Carew Tower, Cincinnati 2, Ohio
8230 Forsyth Blvd., St. Louis 24, Missouri

Circle No. 138, Page 7-8

pouring off the heat

somebody myth-ed a point

■ "Myth" hell, is my claim in regard to Author Weber's conclusion to "Infrared—Does It Cause Cataract of the Eyes" (June, page 107.)

Some years ago we had a man of GI age leave our plant to become an instructor and demonstrator for a manufacturer of welding machines. The victim died from malignant cancer after having one eye removed to try and stop the disease.

Myth or no, it is not the electric welding operator who takes the chances. It is the instructor or demonstrator, layout-man, foreman, etc., who does not always wear protective shields and glasses.

H. F. Roberts
Cleveland

Mr. Roberts fails to distinguish between ultraviolet and infrared; or between cancer of the eyes and cataract of the eyes . . . two entirely different diseases. The workman referred to in the column suffered from cataract of the eyes which he claimed was due to infrared radiation.

This workman was not using an electric arc which generates ultraviolet but an oxyacetylene torch, temperatures from which are not high enough (3900 F) in normal practice to generate ultraviolet radiation.

Infrared radiation generated by oxyacetylene welding has not been established as a cause of cataract of the eyes, and ultraviolet radiation generated by electric arc welding has never been established as a cause of cancer of the eyes.—H. J. Weber.

Workers Will Wear Safety Glasses If Properly Fitted

■ Disabling eye injuries can be prevented almost entirely by safety glasses which will be worn, if properly fitted, states Dr. Harry G. Beiling, American Optometric Association.

Discomfort can come from a variety of causes. Improper resting on the nose, temples incorrectly bent, lens centers not matching pupil centers, and dirty lenses.

Other factors influencing the proper fit of corrective-protective goggles are the working distance, hazards of the job, and position of the work.

Periodic checks are important. Vision is constantly changing, especially in persons over 40 years old.

for the asking

Conversion chart for engineers contains common conversions as well as many difficult to locate in reference manuals. *Precision Equipment Co.*
Circle No. 61, Page 7-8

Plant engineering, modernization, mechanization, and materials handling

are discussed in bulletin describing services. *Lester B. Knight & Associates, Inc.*
Circle No. 62, Page 7-8

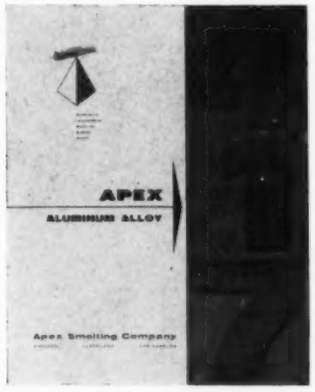
High-speed vibrator catalog, 54 pp, lists entire line used for freeing pattern plates from molds and keeping sand moving feeding freely. Sand arrester tubes, bushings, core box sealers, and other foundry accessories are described. *Martin Engineering Co.*
Circle No. 63, Page 7-8

Immersion-type thermocouple, portable, described in data sheet listing photos of units and test results. Unit measures up to 3100 F. *Bristol Co.*
Circle No. 64, Page 7-8

Fork lift operator's book, 24 pp. covers fundamentals, preventive maintenance, safety and basic materials handling. Cartoon technique employed for easy reading. *Hyster Co.*
Circle No. 65, Page 7-8

Shell core machine, automatic, produces up to 300 complete cycles hourly. Core boxes are blown and cores cured, stripped, and delivered on each cycle. Five-station, rotary-index unit is described in 4-p bulletin which includes dimensioned drawings and specifications. *Beardsley & Piper Div., Pettibone Mulliken Corp.*
Circle No. 66, Page 7-8

Aluminum alloy brochure, in new handy file folder style, gives chemical composition, typical properties, gov-



ernment specifications, and applications for alloy 417. *Apex Smelting Co.*
Circle No. 67, Page 7-8

Centerless grinding, how to obtain maximum results with abrasive wheels, is discussed in booklet form. Includes principles and applications. *Keystone Abrasive Wheel Co.*
Circle No. 68, Page 7-8

Epoxy pattern materials described in bulletin T-24. Resins formulated for foundry pattern equipment. Contains step-by-step procedure for use of epoxies in casting of patterns and core boxes. *Houghton Laboratories, Inc.*
Circle No. 69, Page 7-8

Ceramic strainer core data sheet lists standard and rectangular cores. Also discusses refractory ceramic tubes. *Du-Co Ceramics Co.*
Circle No. 70, Page 7-8

Centrifugal dust collectors are featured in 6-p catalog which includes types and specifications, equipment in use and dimensioned drawings. Information also given on factors to consider in collector selection. *Kirk & Blum Mfg. Co.*
Circle No. 71, Page 7-8

Epoxy resin catalog outlines material said to contain the lowest shrinkage of any cast epoxy. May be poured in any thickness with exotherm not exceeding 200 F. *Furane Plastics Inc.*
Circle No. 72, Page 7-8

Management consultant booklet outlines professional services available including general administration, personnel relations, finance and accounting, manufacturing and operations, sales marketing and distribution. *Business Research Corp.*
Circle No. 73, Page 7-8

Epoxy resin comparative data bulletin covers resins and hardeners, both room temperature and heat curing systems. Information covers physical properties and characteristics. *Houghton Laboratories, Inc.*
Circle No. 74, Page 7-8

Bismuth alloys in the foundry and pattern shop are explained in 12-p catalog. Alloys do not shrink when

Cut foundry operating costs . . .

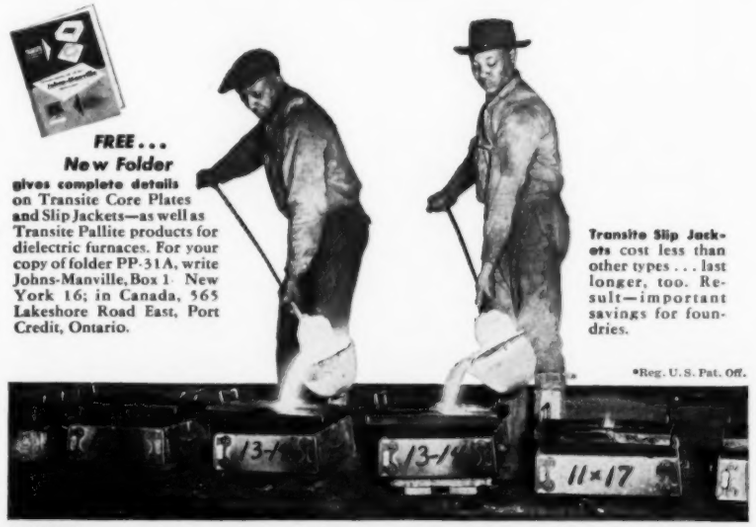
Transite Core Plates are strong and durable . . . resist warpage, impact and abuse, provide long service life.

with Transite Core Plates and Slip Jackets

"Johns-Manville Transite* Core Plates help assure maximum production in minimum time"—that's the experience of foundrymen who have used them for years. Made of asbestos and cement, they are light in weight, yet strong and durable. Being non-metallic, they resist corrosion, maintain their smooth surface and can be easily cleaned.

Transite Slip Jackets are a companion product with similar advantages. They do not burn, retain their original shape despite runouts. Slip jackets are furnished in both white and black types. The latter is widely used as a protective liner for metallic slip jackets.

FREE . . . New Folder gives complete details on Transite Core Plates and Slip Jackets—as well as Transite Pallite products for dielectric furnaces. For your copy of folder PP-31A, write Johns-Manville, Box 1 New York 16; in Canada, 565 Lakeshore Road East, Port Credit, Ontario.



Transite Slip Jackets cost less than other types . . . last longer, too. Result—important savings for foundries.

*Reg. U. S. Pat. Off.

JM Johns-Manville TRANSITE CORE PLATES AND SLIP JACKETS

Circle No. 139, Page 7-8

small addition
gives
BIG RESULTS!

This free brochure tells the whole story of Vancoram V-5 Foundry Alloy. Send for it today—and if you have any problems relating to other ferro alloys, call your nearest Vanadium Corporation Office.

VANCORAM V-5 FOUNDRY ALLOY

(a chromium alloy balanced with manganese and silicon)

- Makes improvement of gray iron easy and economical
- Small additions improve mechanical properties, density and uniformity
- Reduces chill, without formation of open structure in heavier sections
- Eliminates chilled corners and edges
- Improves machinability — lowers machining costs

Vancoram V-5 Foundry Alloy and other alloys for the iron foundry are also available through the following distributors:

Steel Sales Corporation
J. M. Tull Metal & Supply Co., Inc.
Whitehead Metal Products Company, Inc.
Williams & Company, Inc.

VANCORAM

VANADIUM CORPORATION OF AMERICA

420 Lexington Avenue, New York 17, N. Y. • Chicago • Cleveland • Detroit • Pittsburgh

Producers of alloys, metals and chemicals

Circle No. 140, Page 7-8

cast and may be used in sand, plaster, or wood. Melted easily with small gas flame or electric hot plate. *Cerro De Pasco Sales Corp.*

Circle No. 75, Page 7-8

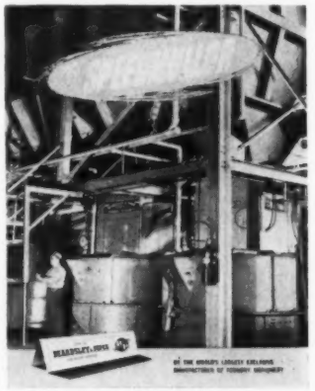
Co_2 process binder is said to react quickly with CO_2 when cores are gassed, resists tendency to be viscous or gummy, promotes maximum collapsibility and minimum of grain shedding, and packs or blows with excellent density. Bulletin F-130 recommends percentages of binder for various AFS sand fineness. *Frederic B. Stevens, Inc.*

Circle No. 76, Page 7-8

Casting defects are discussed in three news letters and two reprints. All five available as a group. Explained are snotters, finish, tolerance, dropping and crushing. *American Colloid Co.*

Circle No. 77, Page 7-8

Mulling machine bulletin, 36 pp, describes line which incorporates centrifugal force applied through horizontally mounted, rubber-tired mul-



ling wheels. Contains dimensioned engineering drawings of numerous installations. *Beardsley & Piper Div., Pettibone Mulliken Corp.*

Circle No. 78, Page 7-8

Overhead chain conveyor system which runs horizontal, straight up or down, or upside down is explained in 4-p catalog. System is completely enclosed and made from prefabricated stock parts. Carries loads up to 240 lb. *Chainveyor Corp.*

Circle No. 79, Page 7-8

CO_2 products for making cores and molds are covered in 4-p technical bulletin listing six binders, coatings and conditioners. Recommendations are made for applications. *Frederic B. Stevens, Inc.*

Circle No. 80, Page 7-8

Industrial ovens for baking, drying, curing, and heat treating are explained in 16-p booklet. One section covers dielectric equipment, others discuss

Foundry Management

Please Note

Your company supervisors are invited to take part in this integrated approach to the Foundry problems of today and tomorrow. Men of vision will find here a unique opportunity to study . . . to compare . . . to learn. Their progress and the speed at which your company moves forward depends upon how well Line Supervision keeps informed on new ideas and methods employed in other successful companies in your industry.

AFS Institute Trustees

H. Bornstein, *Chairman*

G. H. Clamer — F. W. Shipley

H. W. Dietert — I. R. Wagner

L. H. Durdin — B. C. Yearley

W. W. Maloney, *Secretary Treasurer*

S. C. Massari, *Director*

American Foundrymen's Society

Golf and Wolf Roads, Des Plaines, Illinois

f. Metal top and bottom plates clamped to mold allows thin molds. Demonstrate calculated mold permeability
4. Mold Coatings
a. Silica c. Carbonaceous
b. Iron silica d. Cereal
5. Partings
a. Silica b. Non silica
6. Sand Lift
a. Moisture control
b. Sand temperature
c. Pattern temperature
d. Sand strength
e. Pattern surface—demonstrated —different metals and surfaces

I. HIGH FREQUENCY HEATING OF SAND SPECIMEN

1. Exhibit of equipment
a. 0.5 sq. in. sand specimen
b. Application of high frequency heating
c. Gradient heating with radient heat furnace
d. Gradient heating with induction heating

Date:

November 4-8.

Place:

Rackham Memorial, Detroit.

Tuition:

$50—includes: all text material; daily luncheons; official dinner, Thursday.

Course No. 5

Cupola Melting of Iron

I. CUPOLA DESIGN AND CONSTRUCTION

1. Conventional Cupola
a. Size and Melting Capacity
b. Tuyeres
1. *Ratio of Tuyere Area to Hearth Area*
2. *Various types—Including Water-Cooled*
c. Lining
1. *Bottom*
2. *Melting Zone*
3. *Stack*
2. Blowing equipment
a. Types of Blowers
Advantages and Disadvantages
b. Blast Conditioning Equipment
1. *Preheated Blast—types*
2. *Moisture Control*
c. Blast Volume Control
d. Combustion Control

II. RAW MATERIALS HANDLING EQUIPMENT

1. Scrap Handling
2. Scrap Storage
3. Weighing Equipment
4. Charging Equipment
a. Manual
b. Skip
c. Bucket—various types

III. RAW MATERIALS PURCHASING

1. Cast Scrap—various types
2. Wrought Scrap—various types such as rails, forge cropping, etc.
3. Borings and Turnings (Gray Iron, Steel)
4. Steel Punchings
5. Pig Iron—variety available
6. Ferro Alloys
a. Concentration
b. Briquettes
7. Spiegel and Silvery Pig
8. Fluxes—Limestone, Fluorspar, Soda Ash, etc.
9. Inoculating Alloys
10. Fuel—(treated separately)

IV. COKE

1. Types of Coke
2. Sizing and Handling
3. Testing
4. Chemical Composition
5. Variation in Behavior in Cupola
6. Charging
a. Measurement
volume and weight
b. Location in charge and effect on composition of metal
7. Effect of Coke Size on Melting

V. PREPARING THE CUPOLA BED

1. Height of Bed Coke
2. Methods of Ignition
a. Wood
b. Gas or oil
c. Electric
3. Method of Burning In
a. Natural draft b. Induced draft
1. *Compressed air*
2. *Blower*
c. Time required
d. Judgment of proper burning in
4. Maintenance of Proper Bed Height
5. Height of Fusion Zone
a. Check by refractory burn-out
b. Necessity for increase or decrease in coke quantity in after charges

VI. CHARGE PREPARATION

1. Calculation of Charge
a. Proper size of charge
b. Selection of desired composition
b. Approximate analysis of all raw material
d. Loss or gain of elements in melting
e. Calculation of the mixture
1. *Various metals*
2. *Alloys*
3. Coke
4. *Flux*
2. Weighing
a. Metal c. Coke
b. Alloys d. Flux
e. Accuracy required
3. Dumping and Distribution of Charge in Cupola

VII. BLAST

1. Quantity Required
a. Control
1. *Pressure*
2. *Volume*

VIII. CONTROL OF MELTING TEMPERATURE AND RATE

1. Governed by—
a. Coke—air ratio
b. Ratio of coke: metal
2. Excessive Element Loss Due to—
a. Low coke ratio b. Excess blast
3. Effect of Coke
a. Size
b. Chemical reactivity
c. Strength
d. Coking cycle and coal mixture

IX. METAL CONTROL

1. Chill Test
a. Basic means of control
b. Frequency c. Importance
2. Chemical Analysis
a. Frequency b. Valve
3. Arbitration Bar
a. How made
b. Meaning of test results

X. CUPOLA RECORDS

1. Raw Materials
a. Material received
b. Composition
c. Weight used each day
d. Running inventory
2. Daily Mixture Calculation Sheet
a. Typical forms used
b. Actual calculation of several typical mixtures
3. Charging Schedule
4. Daily Log of Cupola Operations
a. Metal temperature
b. Blast volume
c. Windbox pressure
d. Charges melted/how
e. Chill depth
f. Ladle treatment
g. Castings poured and metal used
5. Daily Metal Control Report
a. Chemical analysis
b. Mechanical tests
6. Daily Inspection Report
a. Record of all defective castings related to source of defect
1. *Molding room*
2. *Core room*
3. *Melting Dept.*

XI. DESULFURIZERS

1. Kinds available
2. Mechanism of desulfurization
3. Shop practice—equipment & method of application
4. Factors influencing desulfurization
5. Effect on refractories

XII. FINISHING THE HEAT

1. Control of blast
2. Dropping bottom
3. Disposal of drop
4. Safe practices

XIII. SLAGGING

1. Front slagging—two general types
a. Details of construction
b. Advantages and disadvantages
2. Disposal of slag
3. Color of slag and its meaning
4. Slag composition

XIV. OPERATING PROBLEMS

1. Frozen Tap or Slag Holes
a. How to open
2. Air Losses
3. Keep the Tuyeres Open
4. Bridging
5. Running More than One Mixture
a. Necessary precautions
6. Bottom Run-outs
a. Cause b. Prevention
7. Disposal of Excess Iron

XV. FOREHEARTH AND LADLES

1. Types Available
a. Forehearths
1. *Advantages and disadvantages*
2. *Maintenance*
b. Ladles
1. *Advantages and disadvantages*
2. *Maintenance*

XVI. EQUIPMENT FOR METAL TEMPERATURE MEASUREMENT

1. Types Available
a. Optical pyrometers
b. Radiation pyrometers
c. Immersion thermocouples
2. Application of Each Type
a. Its limitations
b. Care in their use

XVII. CUPOLA EMISSIONS

1. Source
2. Methods Available to Control
3. Control Ordinances

XVIII. ALLOYS

1. In Cupola Charge
2. Ladle Additions
3. How Added and Equipment
4. Available Alloys
a. Graphitizing
b. Carbide stabilizing
c. Effect on metal—graphic representation

XIX. CUPOLA LINING

1. Requirements
a. Melting zone b. Well
c. Charging zone
2. Effect of Operating Conditions on Refractories
a. Mechanical b. Chemical
3. Installation of Lining
a. Pre-fired blocks
b. Monolithic
4. Daily Repairs

XX. COMBUSTION IN THE CUPOLA

1. Chemical Reaction
a. Oxidation b. Reduction
2. Combustion Equilibrium—Charts
3. Control
4. Effect on Loss of Elements
5. Heat Balance

XXI. METALLURGY OF CAST IRON

1. Structural Components
2. Mechanical Properties dependent upon Structural Components
3. Effect of Composition
a. Carbon Equivalent b. Alloys
4. Effect of Cooling Rate
5. Section Sensitivity vs. Properties of Iron
6. Effect of Inoculation
7. Effect of Superheat
8. Effect of Pouring Temperature

Date:

December 2-6.

Place:

University of Illinois, Navy Pier, Chicago.

Tuition:

$50—includes: all text material; daily luncheons; official dinner, Thursday.

Course No. 4
Advanced Sand Technology

STATISTICAL METHODS

Monday

A. FOUNDRY APPLICATION OF SIMPLE STATISTICAL CALCULATIONS
1. Introduction—necessity
2. Labor saving
3. Ability to Solve for more than one variable
4. Ranking statistical method
a. Instruction by foundry sand examples
b. Determination of test data value
1. *Unspired replicates*
2. *Paired replicates*
3. *Groups of replicates*
5. Chi-Square test
6. Number of experiments necessary
7. Factorial design of experiment

B. STUDENTS SOLVE STATISTICAL PROBLEMS

MOLDS

C. MOLD WALL MOVEMENT
1. Introduction
2. Creep deformation—Demonstrations and Test
a. High
b. Low
c. Yield Load
d. Demonstration of wet sand layers
3. Creep Deformation Control
a. Grain b. Lines
c. Bond d. Green strength
e. Mold hardness
4. Casting Quality Affected by Mold Wall Movement
a. Casting weight
b. Casting contour
c. Internal shrinkage
d. Surface shrinkage
e. Casting dimensions
5. Creep Deformation Required
a. Metal
b. Casting height
c. Sprue height
d. Gating

Tuesday

C. MOLD WALL FRACTURE
1. Introduction
a. Movie of mold wall fracture
b. Effect on Casting Quality
1. *Scab imperfections*
2. *Buckle imperfections*
3. *Rat tail imperfections*
2. Demonstration of Sand Expansion
a. High
b. Low
3. Expansion Test Methods
a. Dilation
b. Free expansion
c. Confined expansion
d. Restraining load
e. Expansion under load
4. Expansion Control
a. Composition of Grain
1. *Quartz*
2. *Zircon*
3. *Sillimanite*
4. *Chamotte*
5. Coke
6. *Albany district sands*
b. Mold Hardness—Effect on Expansion
c. Cushioning Materials—Effect on Expansion
1. *Cereals*
2. *Seacoal*
3. *Pitch*
4. *Cellulose Material a. Wood flour b. Cereal mulls*
d. Moisture effect on expansion
e. Grain size effect on expansion
f. Grain distribution effect on expansion
g. Bonds effect on expansion
5. Hot Deformation on Mold Wall
a. Demonstration
1. *Core specimen*
2. *Molding sand specimens*
b. Method of Test
1. *Indicator*
2. *Deformation recorder*
6. Functional Use of Hot Deformation
a. Absorption of expansion
b. Intersection of hot deformation and dilation curves
c. Included area
d. Unaccommodated expansion
7. Hot Deformation Control
a. Grain size b. Grain distribution
c. Pitch d. Sugars
e. Seacoal f. Mold hardness
g. Bonds
h. Cushioning materials
1. *Cellulose*
8. Veining in Molding Sand
a. Excess pitch
9. Casting Quality Improved by Mold Wall Fracture Control
a. Restraining load limits
b. Expansion under load limits
c. Elimination of scabs, buckles and rat tails
d. Reduction at area of flat surface
10. Indirect Causes of Mold Wall Fractures
a. Dry strength
b. Excess fines
c. High green deformation
d. Low green strength
e. Combination of high hot strength and high expansion
f. Excess mold hardness
g. Excess moisture
h. High green density

Wednesday

D. MOLD ATMOSPHERE
1. Introduction
a. Movie
2. Mold Atmosphere Control
a. Carbonaceous
b. Chemical treatment
3. Mold Atmosphere Effect on Casting Quality
a. Penetration b. Casting finish
4. Mold Atmosphere Effect on Heat Transfer
a. Demonstration
1. *Oxidizing atmosphere*
2. *Reducing atmosphere*

E. HEAT TRANSFER THROUGH MOLD WALL
1. Temperature gradients in mold
2. Temperature gradients in core
3. Temperature gradients
a. Oxidizing atmosphere
b. Reducing atmosphere
4. Heat Transfer
a. Grain size b. Permeability
c. Density
5. Heat Transfer Effect on Casting
a. Grain size b. Strength

F. MOLD MECHANICAL SAND PROPERTIES
1. Mold Hardness Testing
a. Mold wall fractures
b. Casting finish
c. Penetration
d. Swells
e. Casting weight
f. Casting contour
2. Mold Green Strength Calculated from Mold Hardness
3. Mold Permeability Calculated from Mold Hardness
4. Mold Permeability Testing
5. Moisture Content of Dried Mold Determination
6. Dry Hardness
7. Mold Hardness Control
a. Squeeze ramming
1. *Contoured squeeze plate*
2. *Peening*
3. *Air pressure*
b. Jolt
1. *Sand depth*
2. *Machine maintenance*
3. *Number of jolts*
c. Sand Slinger
1. *Head movement*
2. *Green sand toughness*
d. Diaphragm molding
1. *Brief description*
8. Sand Workability
a. Sand volume
1. *Moisture—demonstration*
b. Sand toughness
1. *Strength—deformation*
2. *Low strength sand and high strength sand tempered to same degree of toughness—demonstration determine flowability rammability*
c. Aeration
1. *Unaerated sand and aerated sand rammed with same energy —determine permeability strength, deformation, sand toughness and mold hardness—demonstration*
9. False Voids
a. Visual inspection—demonstration
1. *High toughness*
2. *Low toughness*
b. Additives influencing false voids
1. *Grain size*
2. *Grain shape*
3. *Bonds*
4. *Cellulose materials*
5. *Chemicals*
c. False void measurements
1. *Indicator*
2. *Rowell*
3. *Fairfield*
d. False void control
1. *Sand toughness*
2. *Sand composition*
e. False voids due to sand sticking
1. *Sand temperature*
2. *Thoroughness of bond coverage*
3. *Moisture*
4. *Pattern surface*
5. *Partings*
6. *Green strength*
7. *Sand dried out*
8. *Hot sand*
10. Mold Edges Crumbly
a. Air-set strength test method
b. Air-set strength control
1. *Moisture*
2. *Water soluble cereal binders*
3. *Sugars*
4. *Moisture loss in sand before ramming*
d. Value in hydraulic tested casting
11. Tooling Ease of Mold Surface
a. Sand toughness
b. Means of reducing fins at parting
c. Weight control
d. Ability to take uneven bottom boards

Friday

G. METAL PENETRATION INTO MOLD SURFACE
1. Mechanical Penetration
a. Low mold hardness
b. False voids due to low flowability
c. Ferro static pressure
d. Mold wall fractures
e. Wetting action
2. Chemical Action Penetration
a. Exothermic action
b. Gaseous travel
3. Metal Penetration Control
a. Mold hardness control
b. Sand grain size control
c. Use of mold atmosphere
1. *Carbonaceous materials for iron, i.e., sea coal, pitch or coke*
2. *Avoid oil for leaded brasses*
3. *Well dried molds*
d. Mold coating
e. Sand grain composition
1. *Silica* 2. *Zircon* 3. *Chamotte*
4. *Carbon* 5. *Ceramic*

H. CASTING FINISH
1. Sand Properties
a. Grain size control
b. Permeability control
c. Sand toughness control
d. Flowability control
e. Rammability control
f. Expansion under load control to allow using fine sands
g. Gas volume control
h. Moisture control
2. Ramming
a. High ramming energy
b. Well distributed ramming energy
3. Flask
a. Vented flask walls
b. Vented bottom boards
c. Vented top plates
d. Flask depth influences mold permeability
e. Venting cavities in mold

O. MOLD RAMMING
1. Mold Testing
a. Hardness
b. Broken Surface
c. Cleanliness
d. Flowability Voids
e. Rammability in Restricted Areas
f. Sand Workability in Mold
g. Mold Permeability
2. Mold Inspection
a. Broken Surfaces and Edges
b. Cleanliness
c. Flowability Voids
d. Crush, green and dry
e. Flask barring
f. Core print crush testing
g. Metal line testing
h. Chaplet height determination
i. Chaplet crush
1. Excess, loss of metal line in drag
j. Bottom plate and bedding requirements in reference to sand

P. GATING
1. Hand cut effect on sand
2. Mounted gate effect on sand
3. Cored ceramic gate effect on sand
4. Metal distribution effect on sand

Q. POURING
1. Rate effect on mold
2. Height effect on mold
3. How to use a pouring rate chart

R. SHAKE OUT
1. Cracked castings not sand causes
2. Early shake out
3. Sand lumps
4. Core sand contamination
5. Fines loss

S. SAND RECLAMATION
1. Scrap Removal
a. Magnetic
2. Coating Removal
a. Dry
b. Wet
3. Grading
a. Fines removal
b. Grading
1. Screens
2. Air velocity
3. Water velocity
4. Drying
5. Use of Reclaimed Sand
a. Cores
b. Molding
c. Cost
d. Casting Surface

Wednesday

T. SPECIAL SANDS—THEIR USE AND APPLICATION
1. Zircon
a. Molding
b. Core
2. Chamotte
a. Molding
b. Core
3. Coke
a. Molding
b. Core
4. Cement
a. Molding
b. Core
5. Plaster
a. Molding
b. Core
6. Ceramic
a. Molding
b. Core

U. DEFECT IDENTIFICATION BY EXAMPLES
1. Excess Moisture
2. Blows
a. Molding sand
b. Core
3. Dirt inclusions
a. Wash
b. Loose sand in mold
4. Crush
5. Pin hole
6. Scabs
a. Expansion
b. Erosion
7. Buckle
8. Rat tail
9. Vein
10. Slag
11. Excess ramming
12. Broken Mold
13. Cope down
14. Core pushed down
15. Core raised
16. Chaplet blow
17. Broken core
18. Putty
19. Wet paste
20. Agitation
21. Cold shut
22. Seam
23. Shrinkage
a. Mold wall movement
b. Metal
24. Poor core setting
25. Closed vent
26. Dry sand
27. Swell
28. Metal penetration
a. Molding
b. Core sand
c. Soft ramming
29. Burn-on
30. Rough finish

Thursday

CORES
1. Introduction
a. Oil type binders
b. Synthetic resin type binders
c. Rosin and natural resin binders
d. Sodium silicate binders
e. Cereal type binders
f. Cement type binders
2. Grain Coating
a. Room temperature
b. Elevated temperature
3. Core Sand Workability
a. Blowing
1. Use of cereal
2. Use of light ingredients
3. Moisture control
4. Grain shape
5. Grain distribution
b. Core Stickiness
1. Green strength
2. Composition
c. Sagging
1. Grain shape
2. Impact strength
d. Dripping
1. Overhand strength
e. Cracking or Spreading
1. Cracking strength
f. Green Hardness
1. Ramming control
2. Venting
3. Blow holes
4. Green strength
4. Binder Hardening
a. Heat to evaporate moisture and solvents
b. Heat to cause chemical change
c. Gas to cause chemical change
d. Liquid to cause chemical change
e. Time to cause chemical change (air-set)
5. Core Surface
a. Core hardness
1. Green hardness
2. Binder
3. Baking
4. Moisture
5. Stickiness
b. Hardness on edges
c. Scuffing
6. Core Coatings
a. Silica
b. Non silica
c. Carboneous
d. Core Coating spalling
1. Weak base
2. Depth of penetration
3. Difference in expansion

Friday

7. Metal Penetration
a. Underbaked
b. Coke additive
c. Zircon sand
d. Molding sand additive
e. Clay substance additive
f. Core softening
8. Core Breakage
a. Warm strength
1. Composition of binder
b. Warm detections
1. Slow thermal setting
2. Excess of thermal setting binder
c. Temperature of shake out
d. Ease of core removal
e. Core Stacking
f. Core transportation
9. Core Setting
a. Core excess length
1. Binder composition
2. Moisture control
10. Core Blows
a. Insufficient vents
b. Closed vent
c. Paste in vent
d. Metal in vent
e. Poor seal at print
f. Gas volume
g. Moisture absorption
11. Core Position
a. Poor setting
b. Excess chaplet—down
c. Short top chaplet—up
d. Print pressure incorrect
e. Chaplet stem size
f. Metal temperature
12. Broken Cores
a. Core strength
b. Core setting
c. Core softening
1. Test method
13. Rough Cored Surface
a. Core softening
b. Core stickiness
c. Grain fineness
d. Grain distribution
e. Core coating

Date:
September 16-20.

Place:
Rackham Memorial, Detroit.

Tuition:
$50—includes: all text material; daily luncheon; official dinner, Thursday.

Course No. 3

Foundry Cost Reduction Through Better Methods and Performance Standards

A practical course for foundry time study men with lectures, discussions and practical work conducted under the personal direction of Dr. M. E. Mundel, internationally recognized authority in the field, assisted by a specially selected staff of foundry practitioners.

Monday

Techniques for developing better work methods, from product flow to bench work. Examples and problems for group participation.

Tuesday & Wednesday

The development of time study data and its reduction to practical usable form.

Thursday

Better performance rating and practice at rating. Comparison of levels of performance expected at different foundries. How to evaluate the accuracy of and how to control ratings.

Friday

Using time study for better production control and cost control. How to go ahead and use the material covered during the previous days. Discussion of sample foundry programs.

Date:
September 23-27.

Place:
Marquette University Management Center, Milwaukee.

Tuition:
$120—includes: all text material; daily luncheons.

1957 AFS *Training & Research Institute Courses*

Course No. 1

Sand Testing

COURSE OUTLINE

Moisture Flowability—Rammability Testing
Permeability Testing
Clay Washing
Fineness—Density Testing
Green Strength Gr. Def—Gr. Hardness
Sintering Testing
Core Gas Testing
Combustible Test
Mixing Sand
Hot Strength and Hot Def. Testing
Expansion Testing
Dry Strength—Retained Strength Testing
Air-Set Strength Testing
Core Hardness—Stickiness Testing
Mixing Core Sand—Baking—Bakeability
Core—Overhand—Sag—Cracking—Testing
Core Permeability—Core Gas Testing
Core Strength—Hardness—Gr. Tensile Testing
Discussion Period
Review or Study Periods

A. BASE PROPERTIES
1. Percentage Clay Substance
a. AFS Method
b. Automatic Test Methods
c. Hydrometer Test Methods
2. Grain Fineness
a. Sieve Test Method
b. AFS Average Fineness Number
c. Grain Distribution Calculations
3. Base Permeability
4. Grain Shape
5. Sintering
a. Test Methods

B. GREEN PROPERTIES
1. Moisture Tests
a. Gravimetric
b. Volumetric
1. Calcium Carbide
2. Moisture Indicator
3. Unit Volume
4. Electric Moisture Determination
2. Permeability
a. AFS Standard
b. Orifice Method
c. Calibration
3. Green Strength
a. Compressive
b. Shear
c. Tensile
d. Calibration
4. Green Hardness
a. Testing Method
b. Calibration
5. Green Deformation
a. Testing Method
b. Calibration
c. Stress-strain Test Method
6. Flowability and Rammability
a. Testing Methods
1. Indicator
2. Rowell
3. Fairfield
4. Others
7. Green Density
a. Indicator Method
b. Specimen Weight Method
c. Mold Density

C. AIR-SET STRENGTH
a. Testing Method

D. DRY PROPERTIES
a. Dry Strength
1. Testing Method
b. Dry Density
1. Test Method
c. Dry Hardness
1. Test Method
d. Combustible Test Method

E. HOT PROPERTIES
1. Expansion
a. Dilation—Test Method
b. Free Expansion Test Method
c. Confined Expansion Test Method
d. Expansion Under 1 psi load Test Method
e. Load Expansion Test Method
2. Hot Strength
a. Hot Strength Test Method
b. Calibration
3. Hot Deformation
a. Hot Deformation Test Method Indicator
b. Hot Deformation Test Method Recorder
c. Calibration

F. RETAINED STRENGTH
a. Test Method

G. MIXING
a. Prepare a Clay Bonded Sand
b. Prepare a Bentonite Bonded Sand
c. Prepare a Natural Bonded Sand

H. SAND CONTROL RECORDS
a. Frequency of Tests
b. Method of Recording
c. Method of Plotting

CORE TESTING

A. CORE SAND MIX
1. Prepare a core sand mix

B. GREEN PROPERTIES
1. Green Compression Test Method
2. Green Tensile Test Method
3. Green Hardness Test Method
4. Stickiness Test Method
5. Green Overhang Strength Test Method
6. Green Jolt Strength Test Method
7. Green Cracking Test Method
8. Core Sag Test Method

C. BAKE PROPERTIES
1. Core Baking
2. Bake Hardness Test Methods
a. Dietert Method
b. Campbell Method
3. Core Gas Test Method
4. Bakeability Test Method
5. Core Strength Test Methods
a. Tensile Test
b. Transverse Test

Dates:

(Choice of 3)
July 15-19; August 19-23; September 9-13.

Place:

Rackham Memorial, Detroit.

Tuition:

$100—includes: all text material; daily luncheon; official dinner, Thursday.

Course No. 2

Sand Control for Shop Operations

MOLDING SAND PROCESSING

Monday

A. SOURCE AND SPECIFICATION
1. Natural Bonded Sands
a. Grain Size Range
b. Green Strength
c. Green Permeability
d. Percentage Clay
2. Silica Sands
a. Washed and Dried Silica Sands
b. Grain Size Range
c. Base Permeability
d. Grain Shape
e. Grain Distribution
f. Sintering Point
3. Lake Sands
(Same steps as in Silica Sands)
4. Dune Sands
(Same steps as in Silica Sands)
5. River Sands
(Same steps as in Silica Sands)

B. TRANSPORTATION
a. Train
b. Boat
c. Truck
d. Small Lots

C. SAMPLING
a. Hand
b. Sampler

D. UNLOADING
a. Crane
b. Hand
c. Bottom
d. Suction
e. Power Truck

E. STORAGE
a. Open
b. Bins
c. Silo

F. DRYING
a. Coke Stoves
b. Rotary Dryers
c. Steam Pipes
d. Heated Floor

G. COOLING
a. Cooling Towers
b. Shake out Belt Cooling
c. Water Cooling
d. Rotary Coolers
e. Bin Cooling
f. Fines Loss

H. MIXING
a. Mulling
1. Types
b. Kneading
c. Pug Mills
d. Aerator
e. Shovel

I. ADDITIVE AND BOND ADDITIONS
a. Volume Measures
b. Weight Measuring
c. Automatic Types

Tuesday

J. WATER ADDITION
a. Measures
b. Water Meter
c. Automatic
1. Computing Types
2. End Point or Batch Types
3. Deformation Method

K. MOISTURE CONTROL TESTING
a. Rapid Moisture Tests
1. Moisture Teller
2. Calcium Carbide
3. Automatic Recording
4. Temper Determination

L. AUTOMATIC TESTING
a. Permeability
b. Green Strength
c. Green Deformation

M. AERATION
1. Function
a. Properties before aerating
b. Properties after aerating
2. Method of Aeration
a. Brush
b. Combing
c. Throwing Wheel

N. STORAGE AND SAND TRANSPORTATION
a. Bins
b. Hoppers
c. Boxes
d. Belts and bucket conveyors
e. Reciprocating conveyors
f. Floor
g. Bin or Hopper feeding
1. Linings
2. Pulsators
3. Insulation
h. Segregation
i. Fines loss
j. Moisture loss
k. Sand level control

5 *One-Week Courses . . . all Monday through Friday*

No. 1 SAND TESTING

Offered 3 Dates: **July 15-19, August 19-23, September 9-13, 1957.**

Actual laboratory sand testing methods – all essential testing methods for controlling foundry sand – a working course (not a lecture course). Limited to 25.

No. 2 SAND CONTROL FOR SHOP OPERATIONS

Offered only **September 16-20, 1957.**

Lecture course by some of the best qualified sand technologists – covers control of sand to yield acceptable castings – translates test methods into shop control. Limited to 200.

No. 3 INDUSTRIAL ENGINEERING

Offered only **September 23-27, 1957.**

Working course (not a lecture course) in foundry cost reduction through better methods and performance standards – practical course for foundry time study men – discussions and practical work under direction of recognized industrial engineering authorities. Limited to 25.

No. 4 ADVANCED SAND TECHNOLOGY

Offered only **November 4-8, 1957.**

Lecture course in advanced sand problems – designed to meet needs of men of considerable experience in sand technology – a "post-graduate" course for sand technicians. Limited to 200.

No. 5 CUPOLA MELTING OF IRON

Offered only **December 2-6, 1957.**

Practical course in technology of cupola operation from raw materials through operations, metallurgical control auxiliaries and pertinent metallurgy – covers gray iron, malleable iron, ductile iron and duplexing. Limited to 25.

Instructional Staff Will Include:

T. E. Barlow, *Sales Mgr.*, Eastern Clay Products Dept., International Minerals & Chemicals Corp.
J. B. Caine, *Consultant*, Cincinnati
Raymond Daksiewicz, Harry W. Dietert Co.
Harry W. Dietert, *Pres. AFS*
Dr. David C. Ekey, *Tech. Dir.*, Lebanon Steel Foundry
J. A. Gitzen, *Pres.*, Delta Oil Products Co.
A. L. Graham, *Research Eng.*, Harry W. Dietert Co.
Henry Johnson, Harry W. Dietert Co.
Prof. Richard W. Heine, University of Wisconsin
W. W. Levi, *Chief Met.*, Lynchburg Foundry Co.
T. V. Linabury, *Dev. Engr.*, National Engineering Co.
Charles Locke, *Pres.*, Crucible Steel Castings Co.
S. C. Massari, *Dir.*, AFS Training & Research Institute
R. L. McIlvaine, *Exec. Vice-Pres.*, National Engineering Co.
C. E. McQuiston, *Quality Control Mgr.*, Advance Foundry Co.
Dr. Marvin E. Mundel, *Vice Dir.*, Marquette Management Center
O. Jay Myers, *Vice-Pres.*, Foundry Div., Reichhold Chemicals, Inc.
Victor Rowell, *Exec. Vice-Pres.*, Harry W. Dietert Co.
J. S. Schumacher, *Chief Engr.*, Hill & Griffith Co.
T. W. Seaton, *Sales Mgr.*, American Silica Sand Co., Inc.
J. A. Westover, *Vice-Pres. & Fdry. Div. Mgr.*, Westover Foundry Engineers
H. H. Wilder, *Mgr. Engr. Sales*, Vanadium Corp. of America
E. C. Zirzow, *Dir. Fdry. Service*, Werner G. Smith, Inc.

THE AMERICAN FOUNDRYMEN'S SOCIETY, through the *AFS Training & Research Institute,* now offers an intensive program of job training for Line Supervisors designed to:

1. *Help the Foundry Industry retain valuable Manpower through a plan of progressive In-Plant advancement.*
2. *Provide up-grading opportunities for existing personnel through a series of Job-Training Courses.*
3. *Enable Management to realize operating benefits through greater personnel efficiency and improved technology.*

Few industries have matched the Foundry for keeping pace with modern engineering advancements, but heretofore progress has been largely dependent upon the development of techniques and mechanization. Today, Foundry Management is confronted with its greatest challenge . . . the training of Manpower to capitalize fully upon the new methods . . . materials . . . machines.

To link technology with production, the *AFS Training & Research Institute* is offering Management a New Opportunity to realize maximum return from its investment in Manpower . . . to assure Management of competent supervisory personnel by inaugurating a program of efficient, specialized Job-Training Courses.

Program Leaders (the "faculty") for these 5-day courses will be outstanding men of industry, fully qualified by performance to conduct concentrated, intensive courses of study in specific Job Training. Their practical contributions will augment the work of engineering educators and the AFS Institute Staff.

Attendance in each course will be limited to insure constant, personalized instruction. All Instituté courses will include tests and personal progress reports to Management. Because of their practical nature, the courses will not include academic accreditation or scholastic degrees. Sessions for each course have been patterned to adequately cover the particular subject involved. Registrants may attend as many consecutive courses as practical, in line with the goal of management and the individual's desire for technical advancement.

Where the Courses Will Be Held

Above left: Marquette Management Center, Milwaukee
Left: Rackham Memorial, Detroit
Above right: University of Illinois, Chicago

Announcing

An Industry-Wide Program for In-Plant Foundry Personnel Advancement

5 practical courses in 1957

No. 1 Sand Testing *(choice of 3 dates)*

No. 2 Sand Control for Shop Operations

No. 3 Foundry Cost Reduction Through Better Methods and Performance Standards

No. 4 Sand Technology *(advanced)*

No. 5 Cupola Melting of Iron

Sponsored by Training & Research Institute

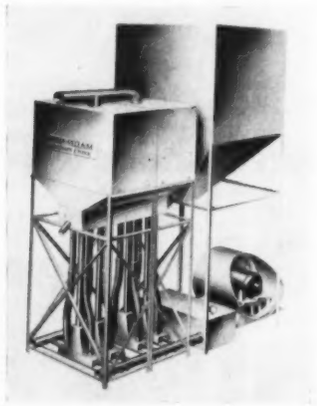
AMERICAN FOUNDRYMEN'S SOCIETY

Golf and Wolf Roads
Des Plaines, Illinois

batch and conveyor type ovens and air-recirculating ovens. *Young Bros. Co.*

Circle No. 81, Page 7-8

Foundry sand reclamation system uses pneumatic scrubbers. Unit and auxiliary equipment can be intedrated into overhead sand handling and storage systems of large foundries. Package unit serviced by front end-loaders, available for small foundries



without overhead systems. This unit requires 14x17 ft floor space and 21 ft head-room. Gravity feed is used. Bulletin 2000 details installation, operation and maintenance procedures. *Beardsley & Piper Div., Pettibone Mulliken Corp.*

Circle No. 82, Page 7-8

Brinell hardness testing machine, motorized, automatically projects magnified image of ball impressions on calibrated screen. Test cycle is infinitely variable from 6 to 60 sec. Limit stops on screen allow operator to see whether or not sample meets specifications. Bulletin A-15 illustrates Brinell indentation as seen by operator and describes operation. *Testing Machines Div., Gries Industries, Inc.*

Circle No. 83, Page 7-8

Zirconium oxides, available in pure or stabilized form, are featured in 4-p bulletin which includes physical properties, types, and applications. Inert to oxidizing and reducing atmospheres and most chemical reactions. *Zirconium Corp. of America.*

Circle No. 84, Page 7-8

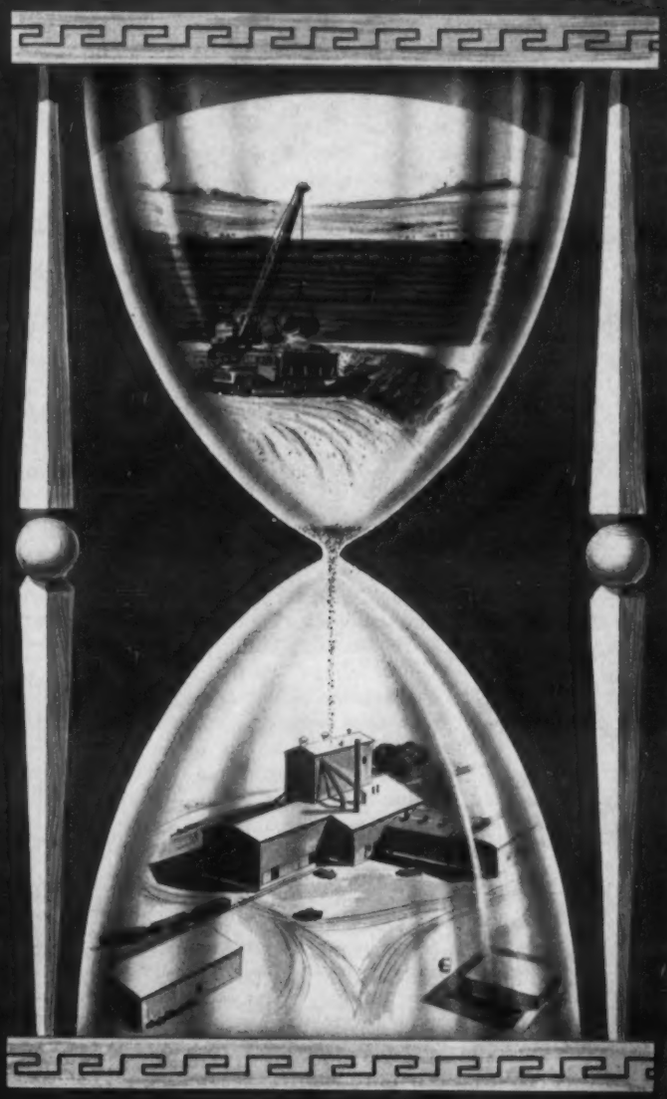
Dielectric sand core oven reduces core baking to minutes with saving in handling, mulling, and cleaning time. Said to bake evenly despite differences in core height or section without over-burning or under-curing. Bulletin 15B-7306D explains operation of dielectric oven, lists typical

Circle No. 85, Page 7-8

Continued on page 56

Circle No. 141, Page 7-8

TIME WILL TELL . . .



SUPPLY . . .

should have an important bearing on any foundry's decision to standardize with one bentonite brand. Any abrupt change in the clay's characteristics due to depletion of the supplier's original reserves can needlessly disrupt casting operations in the future.

More than 200,000 tons of the finest collodial bentonite, YELLOWSTONE, are stockpiled at Magcobar's Greybull, Wyoming, facilities, along with more than 20,000,000 tons of the purest known western bentonite ore in reserve. The world's largest mine — the world's largest reserves!

DEMAND . . .

for Magcobar's YELLOWSTONE continues to increase as more and more progressive foundries discover that up to ten percent less of this pure, uniform clay is required. Uniform green strength, tensile strength and permeability are controlled at the plant to assure consistent specifications.

The next time you order bentonite, demand YELLOWSTONE Bentonite — your guarantee of dependable supply and uniform quality. Write for technical bulletins numbers 1 and 2 entitled "Bentonite Evaluation" and "Bentonite and the Muller."

YELLOWSTONE
BENTONITE

"OLD FAITHFUL"

MAGNET COVE BARIUM CORPORATION
Des Plaines, Illinois, 576 Northwest Highway
Houston, Texas, P. O. Box 6504
Greybull, Wyoming

IS CO_2 NECESSARY?

Compressed air or nitrogen will also harden sodium silicate-bonded cores

CARL E. WULFF *Instructor in Metallurgy*
University of Wisconsin
Madison

The CO_2 process was so named because of its dependence on using CO_2 as the hardening agent for the sodium silicate bonded sand. Work just completed at the University of Wisconsin has revealed the rather surprising fact that CO_2 is not necessary in the process. Small cores may be hardened equally as well, if not better, by using dry nitrogen or dry compressed air. Sand mixing in a closed muller has been found advantageous because it prevents premature setting of the binder.

In testing sodium silicate bonded sand cores, several ways of hardening cores were noted. Some of the methods of solidifying the binder were: allowing cores to set at room temperature, placing cores in oven, gassing with various gases such as nitrogen, and gassing with heated compressed air. All these methods worked, but with varying degrees of success.

Three Gasses Used

Three gases, carbon dioxide, dry nitrogen, and dry compressed air, were checked as to their ability to harden sodium silicate bonded sand. The carbon dioxide was commercial grade and nitrogen was the commercial dry type. Air at 85 psi was taken from the compressed air line. Moisture was removed from the air and nitrogen by passing them through a calcium chloride drier. The drier consisted of a one-and-a-half inch pipe, thirty-six inches long, filled with two pounds of calcium chloride.

Silica sand used in the test had an AFS grain fineness number of 50. All moisture was removed from the sand by drying in a core oven, cooling to room temperature. Twenty-five hundred grams of sand and 112 grams of sodium silicate binder (2-½%) were mixed in a laboratory muller. After mixing for six minutes, the sand was placed in an airtight container.

Gassing Procedure

Standard tensile specimens of the sodium silicate bonded core sand were produced by three rams on the standard sand rammer. Gassing was performed while the sample was in the core box; the gas entering at the top of the core and ex-

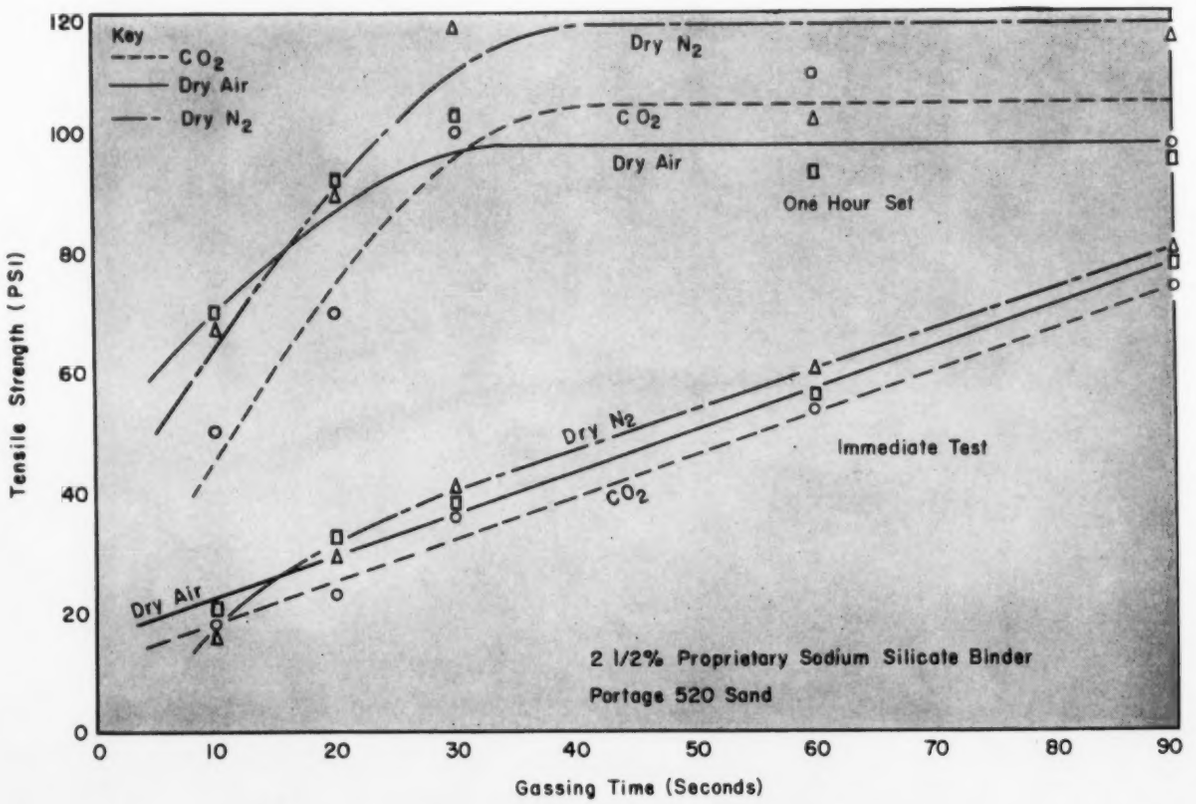


Fig. 1 . . Cores dried with different gasses show similar strength.

iting through a 40-mesh screen at the base of the core. Pressure of the air, nitrogen, and carbon dioxide was reduced to 10 psi in each case before entering the core box. For all samples, the same pressure-reducing valve and gassing equipment was used.

Tensile specimens were gassed for various periods of time up to ninety seconds. One set of samples was tested immediately after gassing, while a second set was allowed to remain one hour at room temperaure before testing on a universal sand-strength testing machine.

Test results are shown by the curves on the graph of Fig. 1. Tensile strength of the samples tested immediately after gassing increased uniformly with gassing time. No appreciable differences in strength seem to result from gassing with dried air, dried nitrogen, or carbon dioxide. The slightly higher values from gassing with nitrogen were probably due to the use of very dry nitrogen obtained by passing the gas through a chemical drier.

Lower values of the carbon dioxide gassing may be due to a slight amount of moisture in the gas and a somewhat lower gas temperature due to its expansion. When test samples were allowed to air-set, considerable gain in strength resulted. Long periods of gassing appeared to have no advantage.

When dry gases were used to harden larger cores it was found that the drying of the sodium silicate binder was too slow a process. The carbon dioxide gassing gave larger cores a quick set although the strength and scratch hardness was considerably below that achieved with further atmospheric drying.

Drying During Mulling

As loss of moisture is a critical factor in hardening a sodium silicate binder, it was deemed worthwhile to investigate mixing of binder and sand from this viewpoint.

Three conditions of mixing were established: 1) closed muller, 2) open muller, and 3) air-blown at muller. The mixer used in this test was a standard 18 in. dia. laboratory muller. The muller was closed with a sheet metal cover which for all practical purposes restricted the movement of air into and out of the muller.

Mulling in the open muller was carried on in normal manner, i.e., the sand, wheels, and plows exposed to the atmosphere. In order to stimulate the movement of air about and into the muller, air was directed at the muller by means of a fan for the third condition.

Ten pounds of silica sand (AFS 50 gfn) was placed in the muller with 2-½ per cent proprietary sodium silicate binder. Every two minutes after the start of the tests, a sample was withdrawn. A tensile specimen was produced with three rams of the standard rammer and then gassed with carbon dioxide for twenty seconds. The specimens were allowed to air-set for six hours and then tested in the universal sand-strength testing machine.

Fig. 2 shows mulling time versus tensile strength for the three conditions. With the muller closed the practical mulling time can be considerably extended up to 16 minutes. It was not until 22 minutes that the sand mixture picked up an appreciable amount of stiffness.

In the case of the open muller the sand reached its peak tensile strength in four minutes and then fell off rapidly. In six minutes the sand was very stiff and for most purposes unusable. When air was directed at the muller by means of a fan, the tensile strength at the end of two minutes mulling was comparatively low and decreased with additional mulling time. In this case the core sand hardened before all the binder was mixed into the sand. When the closed muller was used the sand stuck and hardened only on the base plate. With the open and fan-directed air operation the wheels, sides and plows were heavily coated with sand.

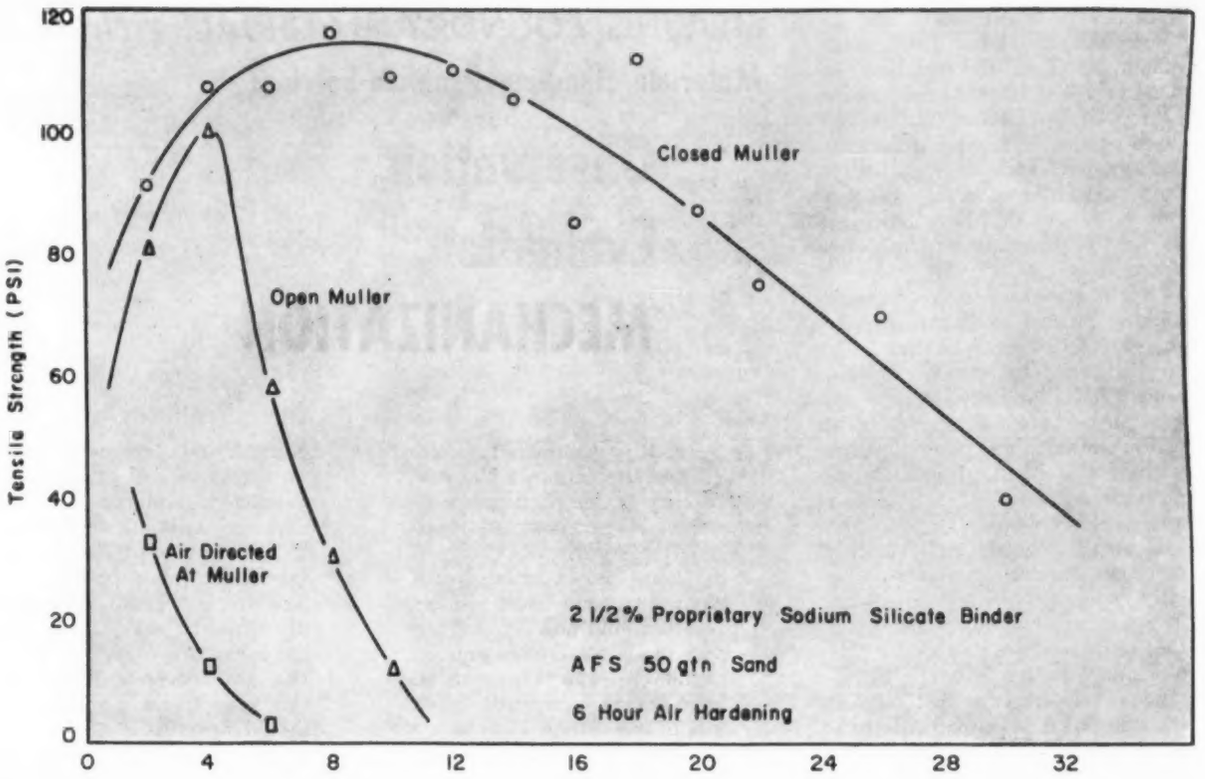


Fig. 2 . . Plot of tensile strength against mixing time in minutes establishes benefits of closed milling. Mixing in closed muller produces stronger gas-dried cores.

Conclusions

For small cores, initial set and hardening can be accomplished by action of a dry gas in removing moisture. Larger cores require carbon dioxide gas to produce the initial set. The most efficient manner appears to be gassing for a short period to produce enough set for handling and allowing moisture loss in the atmosphere to accomplish the necessary strength.

Sand mulling is best in a sealed muller for the following reasons:

- Mulling time is not so critical.
- Over mixing and presetting, resulting from long mixing, are not as likely to occur.
- Peak tensile strength can be attained since binder has sufficient time to mix thoroughly.
- Muller is less likely to be coated with hardened core sand.
- Sand which has partially dried out during mulling will have reduced bench life.

MOVING FOUNDRY MATERIALS—No. 3

Materials Handling Problem-Solving:

Observation, Evaluation, MECHANIZATION

RALPH A. PETERSEN
District Manager
Pangborn Corp.
Birmingham, Ala.

It has been estimated that 25 per cent of all labor cost in manufacturing is in the handling of materials. This figure refers to industry as a whole. Without a doubt, there is more handling in the foundry. Therefore, the castings industry has the most to gain from the techniques that have been developed in materials handling over the years.

Captive foundries and most larger jobbing foundries have already recognized that much of their labor cost is in the handling of materials. Since these larger foundries appear to be better equipped financially, and have manpower to cope with the problem, this article is primarily directed at the smaller and medium shops.

Generally, the factors affecting materials handling are fundamentally concerned with plant layout. Frequently, a thorough analysis of the movement of materials will eliminate needless handling operations. Therefore, the first step in the analysis of any materials handling project must be the careful consideration of the flow of materials through the various foundry operations.

Analyzing The Problem

To plan a materials handling system which will be the most suitable, practical and economical, a definite set of contributory factors must be examined and coordinated. Many of these factors are often overlooked or by-passed; consequently recommendations are based largely on superficial observation. A scientific analysis of the materials handling problem will usually reveal the fallacies in superficial conclusions.

It is well to keep the following in mind when analyzing the materials handling problems:

- Once money is expended in handling materials it is gone forever.
- The greater economy is obtained as the ratio of equipment investment to unit of materials handled is reduced.
- Economy in materials handling is obtained as the size of the handled unit is increased.
- Economy is determined by performance, which is measured by comparative expense per unit of materials handled.
- The determination of the best practice under particular conditions is necessary to maximum economy.
- Economy is obtained when equipment and methods are replaced by new equipment and methods, if the expense of the replacement is exceeded by economies effected within a reasonable time.
- Economy in materials handling is obtained by the use of equipment and methods that are capable of a variety of uses or applications.
- Economy is obtained as the speed of the materials handling equipment is increased, provided the cost of the increased speed is exceeded by the savings.
- The productivity of equipment is increased if repairs and replacement are anticipated.
- Productivity is increased as safe working conditions are provided.
- Productivity of men is increased as fatigue is reduced by provision of mechanical handling equipment.
- Economy is obtained when materials are moved by gravity.
- The unit expense of materials handling increases as the quantity to be transported exceeds the capacity of the equipment.
- The experiences and ideas of everyone in the organization should be utilized.

The tool found most useful in analyzing the materials handling problem is the "flow process chart". A flow process chart is a graphic representative of the sequence of all operations, delays, transportations, inspections, and storages occurring during a process or procedure. It includes information considered desirable for analysis such as time required and distance moved.

A master flow process chart should be prepared, starting with the incoming raw materials and following completely through the foundry until the castings are shipped.

The next most important tool is a reasonably exact plant layout drawing, preferably drawn to a ¼″ = 1′0″ scale, showing the relative positions of the various storage locations and equipment locations with flow lines superimposed.

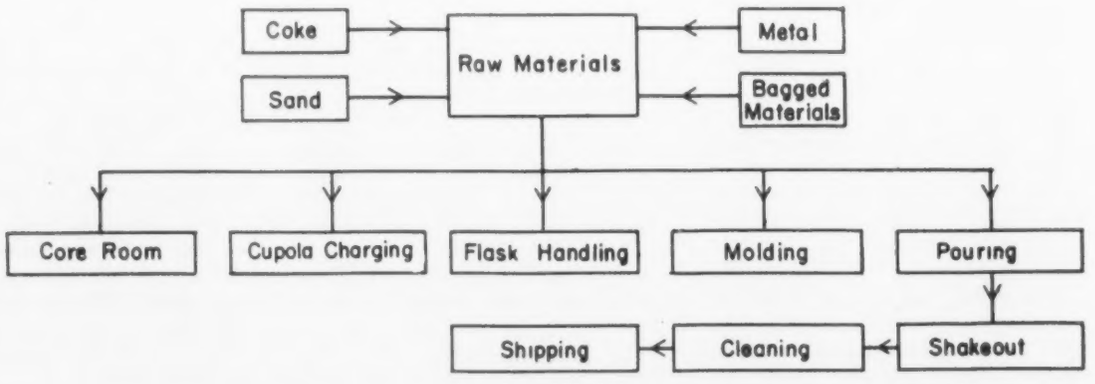
A Case Study

Materials handling problem-solving is a detailed operation and may best be described with a case study.

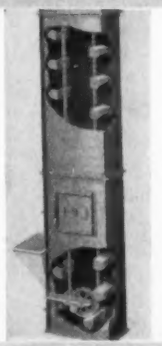
On the following pages is a hypothetical case study illustrating a condensed approach that may fit the needs of the small shop. Assume our plant layout has been thoroughly studied, and all possible improvements have been noted. A master flow process chart of the present operation has been prepared. We are now ready to begin the analysis. In the analysis, an observer's report of each basic operation is recorded, alternative solutions to the problem are detailed for evaluation, and the best solution for mechanizing the handling operation is selected.

Case study on next page.

FLOW CHART



Operation	Observation	Evaluation	Mechanization
Receiving Raw Materials			
Coke unloading	From the flow process chart we find that it costs more than 8 man-hours to unload a gondola car of coke. This is a hand unloading operation, done with pitchforks.	**Have coke** shipped in *hopper cars*. The hopper cars would be positioned over a hopper under the track. The hopper would discharge onto an inclined belt conveyor. The belt conveyor would run to and discharge on the coke storage area. This arrangement would cut unloading time to approximately 4 man-hours, but requires an expenditure of about $4000. **Since** the plant has a bridge crane, a *clam shell* could be used for unloading. This would speed up unloading, but would result in coke breakage. There would be no capital expenditure since a clam shell is available. **Have coke** shipped in coke *container cars*, 12 containers to a car. These containers would be picked up with the bridge crane, positioned over the coke pile and the container bottom released, allowing the coke to fall through. This arrangement would permit an entire 30-ton car to be unloaded in about 35 minutes, with little breakage, and no expenditure of capital funds.	**Coke container cars are the preferred solution. Use of these cars will reduce handling time from 8 man-hours to 35 minutes and will require no capital investment.**
Sand unloading	Several men equipped with shovels and wheelbarrows are now required to unload sand. Sand is received in box cars, loaded with shovels into wheelbarrows, 64 cu ft capacity, and transported a distance of 75 ft (round trip of 150 ft) to sand storage bins. The operation costs about 18 man-hours a boxcar.	**Install** a *hopper* and *belt conveyor* adjacent to sand bins and under the track siding, a hopper and belt conveyor. Have sand shipped in hopper cars and as the cars arrive, position them over the sand hopper. Sand would be dropped to the belt conveyor below. The belt conveyor would feed to a bucket elevator, that would feed in turn to new sand silos. This arrangement would completely eliminate all labor, but will require considerable capital expenditure. **Purchase** a *portable power belt conveyor*, long enough to reach the sand storage bins. Have the sand shoveled directly on the belt conveyor, thus eliminating the long wheelbarrow trip. The plant layout shows that this conveyor would have to be extremely flexible in order to negotiate the turns and also quite long. Therefore the cost will be rather high. **Use** a *tractor-shovel* of about 12 cu ft capacity to unload sand. This equipment could be run directly into the boxcar from a loading dock (to be constructed), pick up a bucket of sand and transport to the sand bins. The tractor-shovel would carry three times as much sand as the wheelbarrow and require only one-third the time to make a round trip to the sand bins, thus reducing an 18 man-hour job to about 2 man-hours. The equipment is versatile and flexible, allowing its use on many miscellaneous jobs in the foundry.	**Best solution is to mechanize by using a tractor-shovel.**
Bagged materials	Bagged materials result in excessive handling in this plant. Presently, bagged materials are received by trailer truck. The trailer is positioned as close to storage areas as possible. Two men on the truck place the individual bags on a gravity roller conveyor that runs into the bag storage area. Two men in the	**Continue** to have bagged materials shipped by *trailer truck*. However, have the two men stack the bags on pallets on the tail gate of the truck. Pick up the unit load with a fork lift truck (to be purchased) and run into the storage area. Stack unit loads in storage area. As material is required, the fork truck	

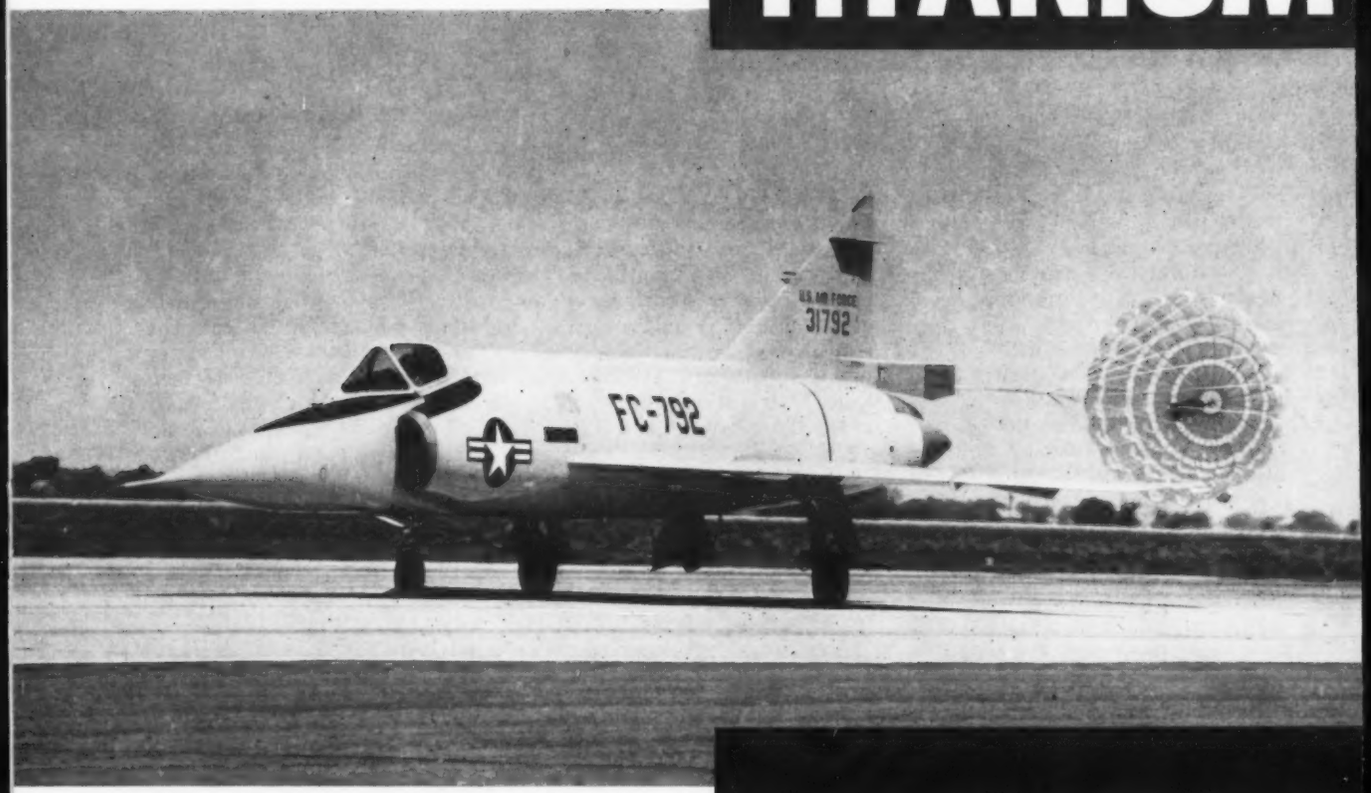
Operation	Observation	Evaluation	Mechanization
Bagged materials (continued)	bag storage area remove the bags and stack them on the floor. When materials are needed, two men with a four-wheel handcart place the bags, one at a time, on the cart. The cart is then wheeled to the operation and bags are removed, one at a time. A sufficient supply for a few days run is stacked on the floor around the operation. Observation over a period of time indicates that, due to this method of stacking and handling, there is as much as 8 to 9 per cent breakage and spillage.	would pick up a unit load and deliver to the operation, thus reducing unloading time by about 25 per cent and the delivery of materials from storage by about 66-⅔ per cent. **Have bagged** materials shipped in *carload lot (boxcar)*. Remove and store as from trailer. This would allow the plant to take advantage of greater quantity discounts and lower freight rates, but would require larger storage facilities. **Have bagged** material shipped in *palletized unit* loads by boxcar. This would permit quantity discounts, reduced freight rate, and would permit a fork lift truck and driver to handle the entire operation of unloading and delivering to the operation. This solution requires the addition of a fork truck, loading dock and larger storage facilities, but will result in about an 80 per cent reduction in unloading and about 66-⅔ per cent reduction in delivery from storage.	**Mechanize this operation by using the fork lift truck.**
Coreroom **Core Sand**	Our analysis disclosed that 16 man-hours per day are spent preparing and delivering our core sand. The operator mulling the sand is utilizing only about 70 per cent of his time mulling sand. A second man is delivering sand to the various core benches and roll ovens by wheelbarrow. At each core making station it is necessary for this man to shovel the sand into the core sand storage hopper. The delivery man's time is about 70 per cent utilized.	**Discharge** the core sand from the muller into a *bucket elevator*. The bucket elevator in turn, would discharge on an overhead belt conveyor. The belt conveyor, running over the core sand hoppers, would be automatically discharged by diagonal plows controlled by the muller operator. Although this arrangement eliminates the core sand delivery man, it is an expensive installation. **Discharge** core sand into a container. Core sand would be picked up by a 12 cu ft *tractor-shovel* and delivered to core sand storage hoppers. This arrangement will also eliminate the sand delivery man, but ties up a man and a tractor-shovel for several hours a day. **Discharge** directly into a *bucket elevator*. The bucket elevator would discharge directly into a hopper suspended from a monorail. The monorail is to be mounted over the sand storage hoppers. After each batch is prepared, the muller operator hand propels a hopper lorry over to the core sand storage hoppers, discharges sand, and returns with the empty lorry to prepare next batch of sand.	**The bucket elevator and monorail-mounted hopper are recommended because this not only permits the elimination of all other labor and is relatively inexpensive, but also permits management to place the muller operator on a sound incentive plan now that he has a full work load.** 
Green core delivery	At present, a large core rack is stationed beside each bench and roll-over. As cores are made they are placed on these racks. As the core racks are filled they are picked up by a hand propelled hydraulic lift truck. One man pulls as two men push the racks to the core ovens. Because of a rough floor in front of the large core ovens, it is often necessary to use as many as six men to move the core racks into the oven. Since only one of the above men is regularly assigned to the task of moving core racks, it is necessary to recruit the aid of coremakers, core assemblers, the muller operator, and sand delivery man when moving racks.	**Rearrange** the coreroom layout placing roll-overs and benches on either side of the powered *belt conveyor*. As cores are made they would be placed on the belt conveyor and travel to the vicinity of the core ovens. Here cores would be placed on the core racks. As a sufficient number of racks of equal baking time accumulates, the man unloading the belt, with the aid of an electric low-lift walkie-platform truck, would place the racks in the ovens. **Make no** changes in the present layout, but purchase the *electric low-lift walkie-platform truck* to aid in moving racks. This would eliminate the interruption of other core room activity. The floor in front of the one oven would be repaired. **Rearrange** the coreroom as in the first suggestion, but purchase a 35-ft *tower oven*. This oven would be loaded directly from a belt conveyor. From the information on the master flow chart we find that 90 per cent of cores could be handled in the batch type oven.	**Use of an electric low-lift walkie-platform truck is recommended.** **Solution of the green core delivery problem is coordinated with the mechanization of baked core delivery.**

this case study is continued on page 77

A Cast Metal for the Future

TECHNOLOGY FOR CASTING

TITANIUM



"It is estimated that a potential market of 3500 tons of titanium castings could be developed by 1960 if a casting industry were established by that time."

A MODERN CASTINGS BONUS

This report is the 25th in a monthly series presented by MODERN CASTINGS to analyze vital problems in the industry. A limited number have been reprinted and are available for 50 cents each.

G. H. Schippereit

R. M. Lang

J. G. Kura

Battelle Memorial Institute
Columbus, Ohio

10 YEARS OF PROGRESS

Supersonic speed and atomic power created demand for titanium

New techniques promise commercial applications

The first serious interest in titanium was started in about 1946. Metallurgists reasoned that the high melting point of titanium, 3140 F, might make it applicable for service at elevated temperatures. In addition, the low density of titanium, approximately 40 per cent that of stainless steel, added to the interest in this metal.

The potentiality that titanium might possess a high strength-to-weight ratio for use at elevated temperatures made it appear particularly attractive for military aircraft, especially the jet planes designed for supersonic speeds.

At the outset, it was logical that our government would subsidize programs to accelerate the development of this new metal. It was also logical that concentrated effort would be directed to the establishment of a titanium industry to supply sheet and other wrought products.

The industry for production of wrought titanium products is fairly well established today. A casting industry has not yet been established primarily because of the much smaller research effort that has been given to it. However, sufficient research has been done to indicate that there is a sound metallurgical basis for the establishment of a titanium casting industry.

The melting and casting of titanium is complicated by the necessity of excluding air from the melt. Molten titanium dissolves oxygen and nitrogen very rapidly and, when contaminated in this manner, it becomes hard, brittle, and difficult to machine. Of the noble gases that do not react with molten titanium, only helium and argon are commercially available in a sufficiently pure state.

The melting process is complicated further because molten titanium reacts with or dissolves all known refractories. When refractory oxide crucibles such as silica, alumina, magnesia, or zirconia are used for melting, the crucibles are severely eroded. The titanium becomes so contaminated that it loses all its desirable mechanical properties.

Graphite as a crucible material resists the chemical action of molten titanium better than the refractory oxides, but still some graphite is dissolved. Titanium melted in graphite crucibles usually picks up about 0.35 to 1.0 per cent carbon. As shown in the following tabulation, small amounts of carbon drastically reduce the ductility and increase the hardness and strength of cast titanium.[1]

Carbon Content, wt per cent	0.04	0.25	0.70
Tensile Strength, psi	70,000	90,000	91,000
Elongation, per cent in 1.4 in.	28	9	2.5
Reduction of Area, per cent	40	11	1.5
Hardness(a), Bhn	158	182	217

(a) 3000-Kg load

The reactivity of molten titanium with all known refractories has been a serious deterrent to the development of casting processes for titanium. Consequently, the development of processes for making titanium castings has lagged far behind the development of processes for melting titanium ingots and fabricating them into wrought products. Titanium ingots are made by melting layers of titanium in a consumable electrode in a water-cooled copper crucible with solidification occurring from the bottom toward the top during melting.

Castings can be made only by pouring a molten pool of titanium into a mold. Even with this additional complication in the melting process, much has been learned about the casting of titanium, and suitable commercial processes are gradually being evolved.

Commercial Process

A commercial process has not yet been developed for production of titanium castings capable of meeting close specification requirements with regard to shape, dimensional tolerances, finish, high strength with adequate ductility, and freedom from deleterious contamination. Industry and government have conducted a limited amount of research to develop a suitable casting process. The fields of investigation covered in part by such research were:

1) Melting furnaces that produce a large, uncontaminated pool of metal for castings.
2) Mold materials that produce uncontaminated castings with a smooth finish.
3) Alloys with good castability and improved mechanical properties.

Significant progress has been achieved in each of these fields.

■ **Consumable-electrode furnaces:** The Bureau of Mines Experimental Station in Albany, Ore., has successfully cast titanium breech blocks weighing up to 75 lb in molds machined from graphite. The melts for these castings were prepared in a consumable-electrode, skull-melting furnace in which a water-cooled copper crucible was employed. The large molten pool of metal, for casting, is actually contained in a solid skull of titanium within a water-cooled copper crucible. Very rapid melting is accomplished by the use of high current density and reduced pressure. Consumable electrodes for the skull furnace can be made

from compressed sponge, titanium ingot, or pieces of titanium scrap welded together. Melts weighing up to 100 lb have been poured with adequate superheat to insure sound castings. This type furnace appears to be quite promising for titanium casting.

■ **Fixed-electrode furnaces:** Fixed-electrode, skull-melting furnaces have also been used for preparing titanium melts weighing as much as 100 lb. Graphite and oxide crucibles have been employed to hold the solid skull of titanium in fixed-electrode furnaces. These furnaces are not so satisfactory for casting titanium as furnaces that employ a consumable electrode because it is difficult to obtain adequate superheat in the melts. In addition, the melts may be contaminated by the electrode or the crucible supporting the skull.

■ **Induction melting:** Induction furnaces are being employed for casting titanium, but the melts are usually severely contaminated by the graphite crucible. Induction-melted titanium with high-carbon content has been used for casting corrosion-resistant valves and pipe fittings, but in these applications good ductility was not of major importance. A limited amount of research by Watertown Arsenal on 5-lb heats, induction melted in a graphite crucible with high-intensity electrical field, suggests that it may be possible to produce titanium castings with carbon contents ranging from 0.066 to 0.15 per cent.

■ **Machined graphite molds:** At the present time, the best molds for producing sound, smooth titanium castings with a minimum amount of surface contamination are those machined from solid blocks of graphite. The maximum depth of surface contamination in castings from machined graphite molds is about 0.010 in./in. of section thickness. This contamination causes an increase in the surface hardness of only 20 Knoop hardness units for sections 1-in. thick. Machined graphite molds have the disadvantage in that they are expensive, are apt to have a short life, are apt to produce laps or rippled finish on castings, and the variety of mold cavities obtainable is limited. Graphite molds having adequate draft, absence of re-entrant angles in a single piece, and expendable inserts in areas subject to erosion or tearing have a life of about 50 castings.

OFFICIAL U.S. NAVY PHOTO

U.S.S. Canberra dramatizes titanium's role in weapons program. Missiles and ship make use of metal's high strength-to-weight ratio and resistance to elevated temperatures and the corrosive conditions of marine service.

■ **Expendable molds:** Small, sound titanium castings with a good surface finish have been made in expendable molds composed of refractory oxides or graphite powder. Four different types of expendable molds have been used with some success;[1] shell molds,[2] baked sand molds,[3] rammed graphite molds, and[4] investment molds. The shell, rammed graphite, and investment molds have been the most satisfactory.

■ **Surface contamination:** All titanium castings made in expendable molds are contaminated to a greater depth than castings made in machined graphite molds. The depths of contamination range from 0.016 to 0.060 in., depending on the section thickness of the casting and the type of mold material. With present expendable mold materials of refractory oxides, it is difficult to obtain good surface finishes on titanium castings with section thicknesses greater than 1/2-in. As the section size of the casting is increased, the amount of mold reaction increases with a consequent roughening and pin-holing of the surface. Castings from expendable molds made of a graphite base have not exhibited any evidence of mold reaction in sections up to at least 1 in.

■ **Precision castings:** Small precision castings of titanium have been made successfully in oxide investment molds, but the surface roughness was greater than that of commercial investment castings made from other metals.

■ **Properties of cast alloys:** Titanium and some of the titanium alloys cast in machined graphite molds have strengths approaching those of annealed wrought titanium of similar composition, but the ductility is somewhat lower. A limited amount of research with cast titanium alloys has shown that no serious problems are to be expected with regard to alloy segregation or unsoundness caused by solidification shrinkage.

■ **Potential market:** There is an immediate potential market for titanium castings in the aircraft, missile, and chemical process industries. Marine and ordnance applications are expected eventually to represent the major portion of the market. It is estimated that a potential market of 3500 tons of titanium castings could be developed by 1960 if a casting industry were established by that time.

TITANIUM CASTING NEEDS:

Melting furnaces that produce a large, uncontaminated pool of metal for casting

The most promising method for producing titanium castings is the consumable-electrode, skull-melting furnace in which the titanium is melted under a vacuum in a water-cooled copper crucible. At the Bureau of Mines Experimental Station in Albany, Oregon, a furnace of this type has been used to cast titanium breech blocks weighing up to 75 lb.

The basic principle of this furnace is to melt the consumable electrode so rapidly that a large bath of superheated metal is obtained and very little of the melt solidifies before it is lip poured. This is accomplished by employing high-current densities and melting under a furnace atmosphere of reduced pressure. Experimental work has shown that maximum melting rates are attained when the pressure of the furnace atmosphere is reduced to just above the point where a diffuse arc, typified by lack of melting, is obtained. The actual pressure at which this maximum melting rate is attained depends upon the location of the vacuum gage in the system.

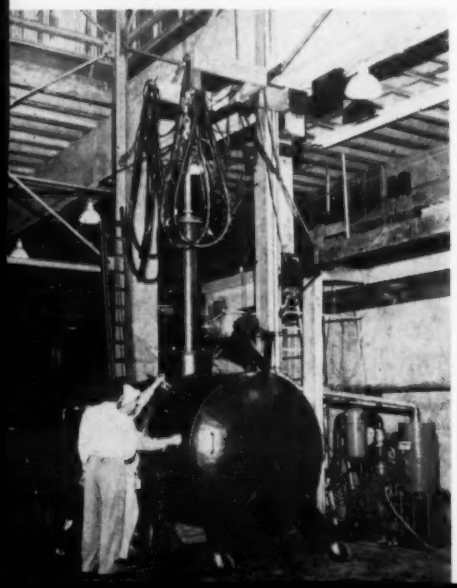


Fig. 1 . . Consumable-electrode, skull-melting furnace is most promising means of melting.

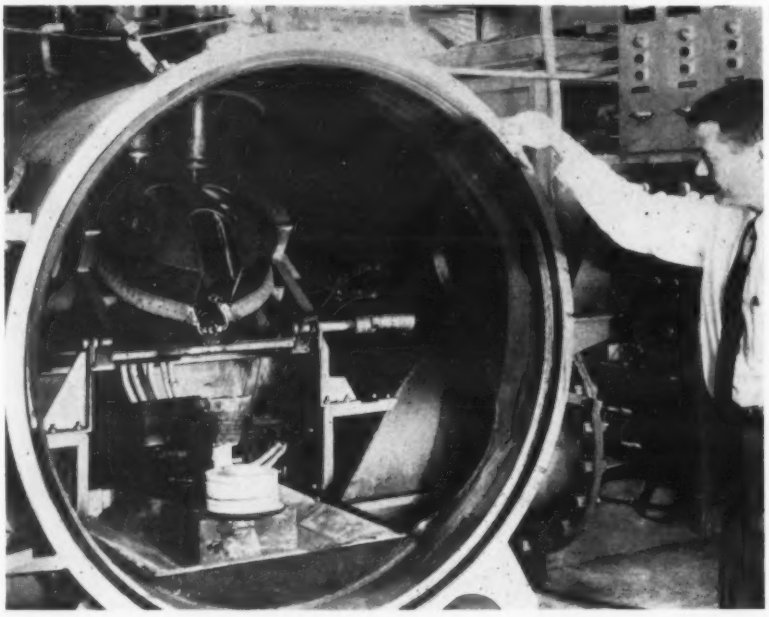


Fig. 2 . . Fixed-electrode, skull-melting unit makes 50 lb castings.

In the Bureau of Mines' practice, the furnace is pumped down to a pressure of about 150 microns and the leak rate is established to be less than 5 microns per min. The optimum operating pressure is 150 microns. With an 8-in. diameter electrode, a current of 8000 to 9000 amperes at 28 to 30 volts is used. A 9 to 10 in. diameter crucible is used for melting and casting 90 to 100 lb of titanium, and the melts are prepared in about 15 min.

After casting, the weight of the skull left in the furnace may be as small as 30 per cent of the total weight of metal charged. This skull is usually left in place for the next melt cycle. A complete cycle from the charging of the furnace to the preparation of the furnace for the next charge is about 2 hr.

Results

Melts from the Bureau of Mines' furnace have a high degree of superheat, and sound castings can be obtained from graphite molds that have not been preheated. Because of its good thermal conductivity, graphite is notorious for chilling castings. With fixed-electrode, skull-melting furnaces, the graphite molds have to be preheated to 1400 to 1600 F since the metal is not superheated sufficiently to obtain soundness and smooth surfaces on castings having sections less than 1 in. thick.

The Bureau of Mines' furnace is quite versatile and can use electrodes made of compacted sponge, titanium ingot, or scrap pieces of titanium welded together. Titanium

alloys can be produced by incorporating the alloying elements in the compacted electrode. The size of the melts can be varied by changing the size of the crucible and the diameter of the electrode. There is very little opportunity for contaminating the titanium in this furnace, and most of the furnace operations can be mechanized.

A bottom-pour, furnace of this type was also investigated by the Bureau of Mines in their earlier research.[2, 3] The bottom-pour furnace was abandoned, however, because it was not possible to control the tapping time, the pouring rate, or the amount of metal poured. This lack of control stemmed from the fact that it was difficult to keep the tap hole clear.

A commercial size furnace of the lip-pour type developed by the Bureau of Mines is shown in Fig. 1.[4] It is operated from a remote station. The horizontal shell is 59 in. diameter and its length is adjustable from 3 to 9 ft. The crucible is mounted directly beneath the vertical electrode[7] housing. Melts may be poured by tilting the crucible[2] in either direction. Rotating tables may be used to index molds next to the crucible so that successive pours may be made without the necessity of opening the furnace. Although the present capacity of the crucible is 100 lb of titanium, a crucible with a capacity of 250 lb could be used without modification to the furnace. The height of the pouring lip is 34 in. from the bottom of the furnace shell. Thus, the maximum size of the casting is limited only by this height, the diameter of the shell, and the length of the shell.

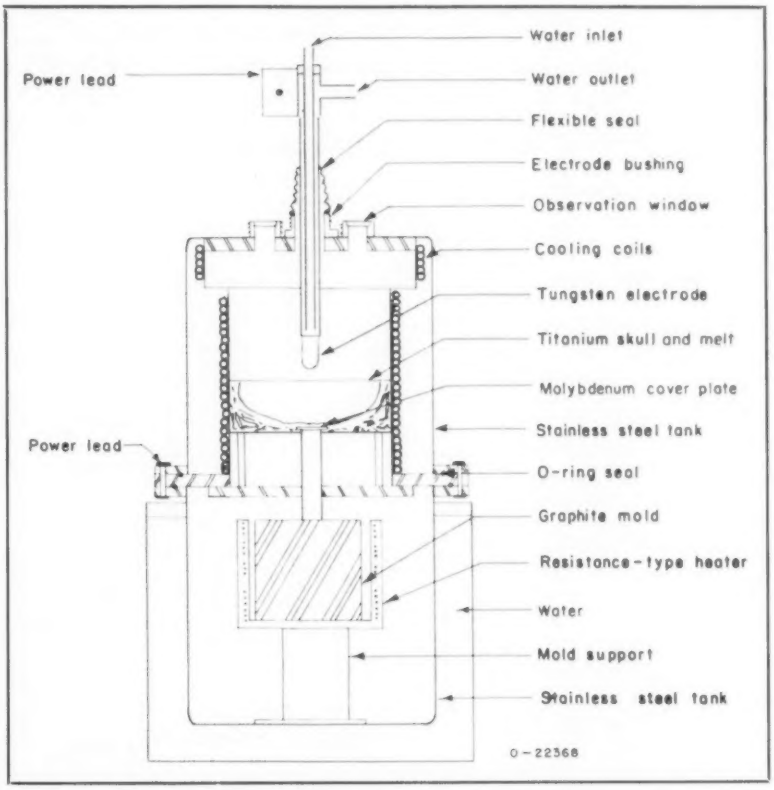


Fig. 3 . . Bottom-pour, cold-mold, skull-furnace model.

Fixed-Electrode Skull-Melting Furnaces

Much of the early research on the casting of titanium was conducted with skull-melting furnaces that employed fixed electrodes of tungsten or graphite. This type of furnace is not so satisfactory for casting titanium as the Bureau of Mines' furnace. It is difficult to obtain adequate superheat in the melts, and there is danger of contaminating the melts with tungsten or graphite from the electrode.

Either tungsten or graphite electrodes may be used in the fixed-electrode furnaces. A tungsten electrode is preferred to a graphite electrode because alloying with a small quantity of tungsten has only a mild effect on the mechanical properties of titanium in comparison with the effect of carbon. In addition, most of the solid particles from the tungsten electrode settle to the bottom of the melt and remain in the skull when the melt is poured.

Unlike consumable-electrode furnaces, many of the fixed-electrode, skull - melting furnaces employ graphite crucibles. A graphite crucible is used as a thermal insulator to permit easier superheating of the bath. To prevent contamination of the melt by carbon from the crucible, the flow of heat is adjusted so that a skull of solid titanium is built up on the wall of the crucible. All melting is done within the skull and, thus, the melt does not come in contact with the graphite crucible. However, it is difficult to maintain the correct heat balance, and occasionally melts may be contaminated by the graphite crucible.

The only commercially available arc furnace for casting titanium is a fixed-electrode, skull-melting unit, manufactured by National Research Corp.[5] This furnace employs three electrodes of either graphite or tungsten. All melting is done in an enclosed chamber under an inert atmosphere of argon at a reduced pressure of about 200 mm of mercury. The melts are poured by tilting the crucible. Castings weighing up to 50 lb can be produced in this furnace, shown in Fig. 2.

With the National Research furnace, the current to each elec-

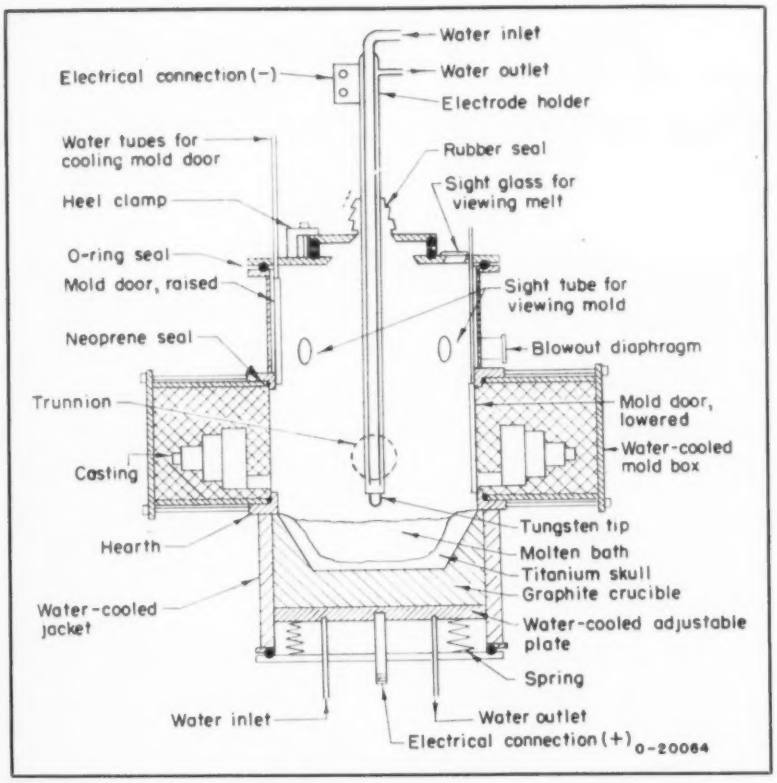


Fig. 4 . . Tilt-pour, skull-furnace has single fixed electrode.

trode is 900 to 1000 amperes at 25 to 30 volts. Approximately 1 kwh is consumed per pound of titanium melted. The carbon content of the melts is reported to be less than 0.06 per cent.

Rem-Cru Titanium, Inc.[6] conducted some research on casting with a skull furnace that employed three graphite electrodes and a graphite crucible. This furnace was similar to the National Research Corp. furnace but was of somewhat larger capacity. A charge consisting of approximately 50 per cent scrap and 50 per cent sponge was used to prepare 100-lb melts. After pouring, about 20 to 35 per cent of the charge remained in the furnace as a skull.

The carbon content of the castings was 0.3 per cent, reducing the ductility of the castings considerably. Some difficulty was encountered also with outgassing of the zirconia refractory that was used to insulate the graphite crucible from the stainless steel container. In addition, the zirconia reacted with the graphite crucible to liberate carbon monoxide which contaminated the melts.

Variations

Other types of skull-melting furnaces employing only a single fixed electrode have been used. They are either bottom-pour or tilt-pour type. A bottom-pour, skull-melting furnace was used by Rem-Cru[7] for research on the casting of titanium. The tap hole was sealed with a sheet of titanium. To pour a 20-lb casting, it was necessary to preheat the crucible, skull, and charge to about 2200 F with resistor heaters that were built into the furnace. During this period, the furnace was outgassed. After preheating, the charge was arc melted in 10 to 15 min; however, the entire casting cycle required 4 hr. Because of the limited capacity and long preheating and outgassing treatments required, this furnace is not considered very practical for commercial use.

Frankford Arsenal used a bottom-pour, cold-mold, skull furnace[8] in its research programs on the casting of titanium. The maximum weight of casting that was made was about 36 lb. This furnace, equipped with a single fixed electrode, is shown schematically in Fig. 3. In a typical cycle for a 25-lb charge, melting is achieved in about 25 min after the arc is started. Melting is conducted with 1600 to 1800 amperes at 30 to 40 volts in an atmosphere of 8 parts helium to 1 part argon.

Although melting is conducted at atmospheric pressure, pouring is accomplished at reduced pressure. The first metal entering the sprue melts a fine copper wire which activates a relay that opens a valve to a vacuum surge tank. Thus, the pressure in the mold chamber is reduced at the very start of the pour, and voids in the casting from entrapped gases are minimized. About 13-1/4 lb of titanium are poured from 25 lb initial charge.

Bottom-pour, skull furnaces have certain disadvantages, regardless of whether or not they use a consumable or fixed electrode. The tap hole is difficult to clean, and the rate of pour and the amount of metal poured cannot be controlled to any appreciable degree.[3]

Tilt-pour, skull furnaces employing a single fixed electrode have also been used for casting titanium. A schematic drawing of a tilt-pour furnace that was used at Battelle[9] to evaluate a wide variety of mold materials is shown in Fig. 4. The disadvantage of the furnace was that, although the skull weighed about 20 lb., the castings weighed only 2 to 3 lb. All melting was done under an argon atmosphere at 1 atmosphere pressure with a power input of 1500 to 2000 amperes at 28 to 30 volts for about 15 min. A Bureau of Mines furnace appears in Fig. 5.

Results

In general, high-purity titanium melts can be prepared in fixed-elec-

trode, skull-melting furnaces, but the melting technique is complex. The operator has to estimate when the molten pool is large enough to fill the mold. If melting progresses for too long a time at too high a power input, there is the danger of melting through the skull to the graphite liner, contaminating the melt with carbon. Also, with this furnace, it is almost impossible to get an adequate amount of superheat into the melts. Because the melts cannot be superheated adequately, molds of machined graphite must be preheated to temperatures as high as 1600 F to assure sound castings free of surface defects.

Induction Melting Furnaces

Armour Research Foundation has done a considerable amount of titanium casting research with a bottom-pour induction furnace lined with graphite.[17] Melting was conducted under an argon atmosphere and approximately 15 lb. of titanium could be poured at a time. The carbon content of the melts was about 0.7 per cent. When the carbon content exceeds 0.7 per cent, the metal is considered unmachinable on a production basis.

The Armour furnace was used to cast valve bodies, seating rings and disks, and pipe tees and ells. Although the castings had low ductility, they were made for marine service where resistance to corrosion was of primary importance and ductility was of less importance.

One of the more serious problems involved in the induction melting of titanium is the difficulty of superheating the melts adequately. As a result, the melts have poor fluidity, and sound castings are difficult to make. The principal difficulty with superheating titanium in graphite-lined induction furnaces is that the melting temperature of titanium-carbon alloys increases as the amount of carbon increases. Hence, the longer a melt is held in an induction furnace, the higher the carbon content of the melt and the higher its melting point.

Watertown Arsenal[18] has developed a technique that may permit titanium to be induction melted in a graphite crucible. They have successfully melted 5-lb heats of titanium without excessive carbon contamination by employing a strong intensity, electrical field to melt the titanium as rapidly as possible. A short melting time, 1 to 2 min. at a power input of 65 kw, minimized the contact time between the charge and the graphite crucible. The strong electrical field also forced the melt to assume a very marked conical shape so that contact between the melt and the crucible was restricted chiefly to the bottom of the graphite crucible. Five-pound ingots of titanium with carbon contents of 0.066 to 0.15 per cent were made from sponge that contained 0.025 per cent carbon.

Watertown Arsenal is increasing the capacity of the furnace to 25 lb. If the carbon content in 25-lb melts can be kept within the range cited for the 5-lb melts, and if a small amount of carbon contamination is permissible in the cast product, then this melting technique should prove suitable for small castings.

Crucible Materials

Much research has been con-

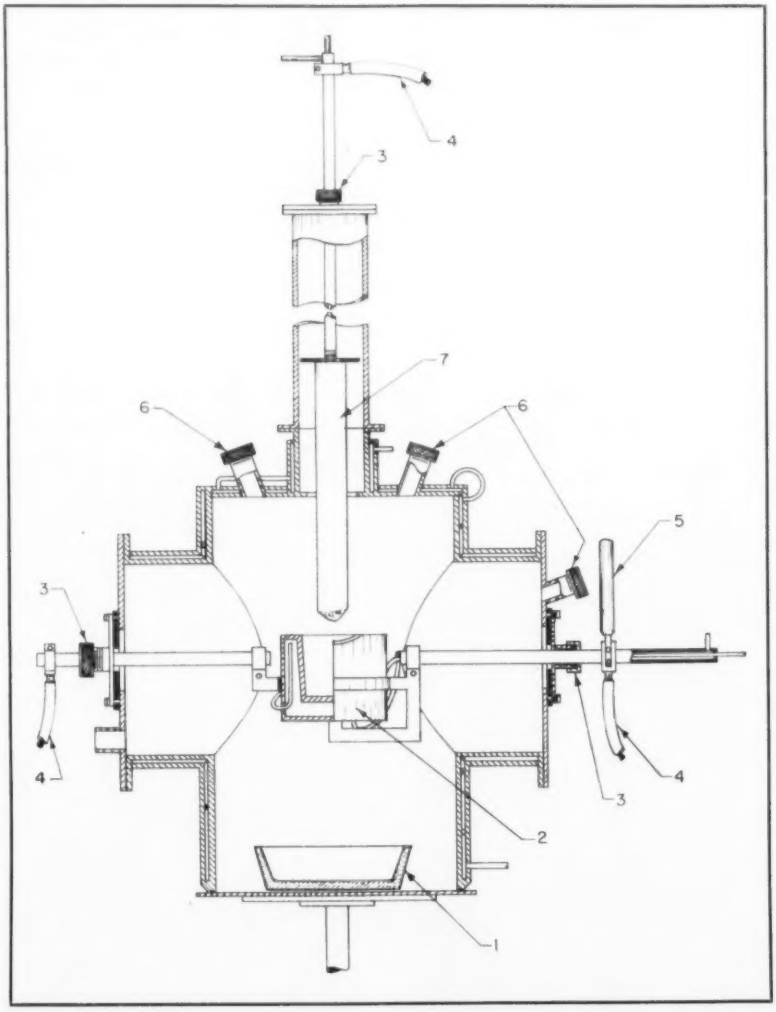


Fig. 5 . . Lip-pour furnace developed by Bureau of Mines research.

ducted to develop a refractory crucible for induction melting titanium.[10 11 12 13 14 15] Various types of carbides, oxides, nitrides, sulfides, borides, silicides, aluminides, and complex compounds were tried as crucibles. Several of the materials showed some promise. Among the more successful materials were cerium sulfide, molybdenum aluminide, and oxygen-deficient zirconia.

Cerium sulfide crucibles[12] could be reused, although some solution of the crucible occurred on each use. The contamination, which appeared as a eutectic sulfide in the structure of the cast metal, increased the hardness and strength and decreased the ductility. For example, a sulfur content of 0.165 and 0.570 per cent in the titanium raised its base hardness of 178 Vickers to 185 and 213 Vickers, respectively. A crucible of molybdenum aluminide Mo_3Al, introduced some but not harmful quantities of molybdenum and aluminum to the melt as a result of slow solution of the compound.[14] Oxygen-deficient zirconia[15] also showed promise.

Graphite-lined induction furnaces, although they markedly reduce the ductility of titanium by contaminating the melt with carbon, have been used for melting and casting titanium. A schematic drawing of a tilt-pour induction furnace is shown in Fig. 6. This furnace was used at Battelle[16] for preliminary screening of mold materials for titanium. All melting was done at a frequency of 9600 cycles/sec under a helium atmosphere. The melting time was 15 to 20 min at a power input of 30 kwh. Castings weighing 2 to 6 lb were made.

Pouring Temperatures

In the casting of all metals, it is desirable to measure the temperature of the melts before they are poured so that an optimum pouring temperature can be established. The optimum pouring temperature is that which produces castings free of laps, cold shuts, seams, and misruns. It varies with the section size of the casting. Large or heavy-walled castings have a lower optimum pouring temperature than small or thin-walled castings. With titanium, however, no suitable method has been developed for measuring the temperaure of the melts before they are poured.

Optical pyrometers cannot be used with induction melting furnaces because so much fume is evolved by the melt that a true reading cannot be obtained. With arc furnaces, the radiation from the arc makes it impossible to obtain a precise measurement of temperature. Furthermore, a large temperature gradient probably exists between the bottom and the top portions of the melt. If the arc is extinguished, the melt cools so rapidly that it must be poured immediately with no time available for an accurate temperature measurement.

At Armour, a tungsten-carbon thermocouple was used to measure the temperaure of titanium melted in an induction furnace.[17] The thermocouple measured the temperature reliably up to the melting point. After the titanium melted, the thermocouple indicated no further temperature increase. The reason for this behavior was not determined.

Rem-Cru has used a radiation pyrometer that was sighted on the spout of a tilt-pour, skull-melting furnace.[19] The radiation pyrometer gave a relative indication of the amount of superheat in the melt as it was poured, but it could not be used to measure the temperature of the melt before pouring.

Because no suitable method for directly measuring the amount of superheat in the melts was available, an indirect method was used at Armour and Battelle. This technique consisted simply of measuring the power consumed after the titanium was completely melted. Power consumption was taken as a measure of the amount of superheat in the melt. Castability was duplicated with a reasonable degree of accuracy by the use of this method.

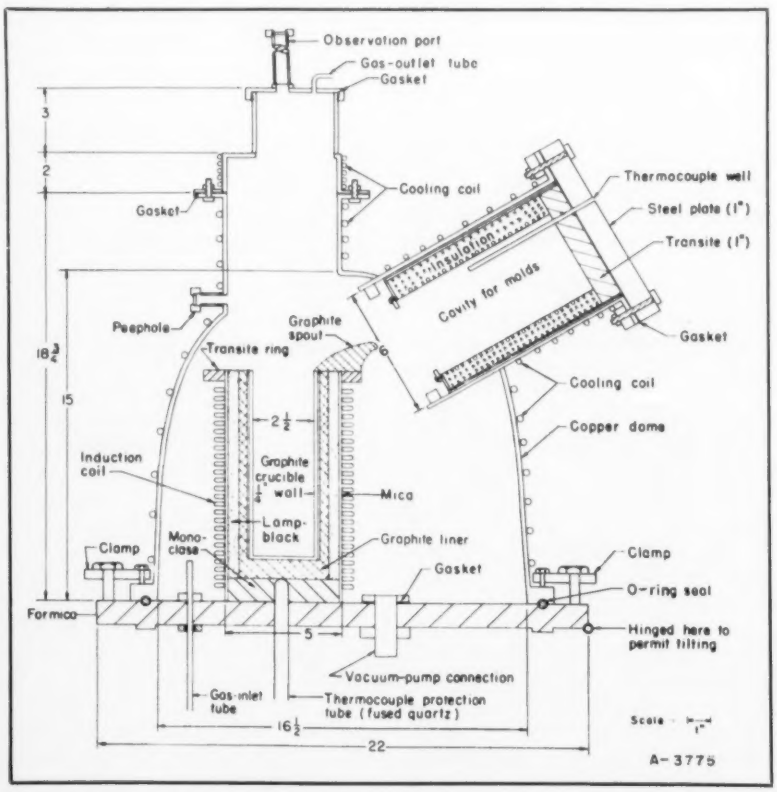


Fig. 6 . . Ductility is reduced by induction melting in graphite.

TITANIUM CASTING NEEDS:

Mold materials that produce uncontaminated castings with a smooth finish

One of the first mold materials used for casting titanium was machined graphite. It is still the best material for producing smooth, sound castings with only a negligible amount of surface contamination. Oregon Metallurgical Corp.[4] reports a depth of contamination of about 0.010 in./in. of casting thickness. The degree of contamination is considered to have a negligible effect on the quality of the casting.

Machined Graphite and Carbon Molds

The chief disadvantages of molds machined from graphite are: 1) they are expensive to make; 2) they have a relatively short life; 3) they are apt to produce laps or rippled finishes on castings; and 4) the mold cavities obtainable are somewhat restricted in variety. Even when used for casting simple shapes, they often begin to crack and spall after being used 30 to 40 times.

Oregon Metallurgical Corp.[4] extends the life of molds to about 50 castings by utilizing expendable inserts at locations that are subject to erosion or tearing. In addition, care is exercised to be certain that adequate draft is used and re-entrant angles are eliminated from single pieces comprising the graphite mold. Although running thin sections depends on the configuration of a particular casting, the practical limit at present is expected to be a section 1/16-in. thick per in. of depth and width. Examples of castings from machined graphite molds are shown in Figs. 1 and 2. The large hole in the single housing casting was cored. The holes in the yoke castings were produced by drilling the castings.

Oregon Metallurgical Corp. also reports success with massive copper molds, Fig. 3. Compared with graphite molds, copper molds have a longer life, but cost is higher and there is a greater tendency to produce cold shuts on the surface of the casting.

Because machined graphite molds have deficiencies, a considerable amount of research has been conducted to find an expendable mold material as satisfactory as machined graphite. Several promising leads have been developed. One such development[20] utilizes a rammable mixture of powdered graphite plus a nonreactive binder. The rammed mold is fired before using. See Bonus Section, May, 1957 MODERN CASTINGS.

Molds machined from carbon have been used,[19] but they are not so good as those machined from graphite. It is easier to make sound castings free of surface laps and cold shuts in carbon molds than in graphite molds because carbon extracts heat from the metal less rapidly than graphite. One of the disadvantages of carbon molds is that molten titanium wets and adheres to the carbon and the molds must be broken away from the castings. Another disadvantage is that carbon molds contaminate the castings to a greater extent than graphite molds.

Shell Molds

Shell molds made from oxide materials can be used for making quality titanium castings with sections up to 1/2-in. thickness. The surfaces of titanium castings made in shell molds, however, are contaminated more severely and to a greater depth than when casting into machined graphite molds. The effect this surface contamination has on service life of castings is

Fig. 1 . . Machined graphite molds used for these unalloyed castings can be used 30-40 times.

U.S. BUREAU OF MINES PHOTO

Fig. 2 . . Mold and core for this casting were machined from graphite.

Fig. 3 . . Four-piece copper mold was employed for this casting.
U.S. BUREAU OF MINES PHOTO

not known.

In research conducted at Battelle[9, 16] shell molds composed of the following refractory oxides (and others) were evaluated: alumina, magnesia, silica, zircon, zirconia.

This research showed that all the refractory oxides contaminated the castings about the same extent.[16, 21] The depth of contamination varied from 0.020 to 0.040 in. on 1/4-in. sections and from 0.030 to 0.060 in. on 1-in. sections of the castings. In contrast, the average depth of contamination when casting into machined graphite molds was only .010 in. for sections up to 1 in. thick.

With refractory oxide shell molds, good surface finishes were obtained on castings with sections 1/2-in. thick or less, but on sections greater than 1/2-in. thick, extensive mold reaction caused pinholes on the casting surfaces. The use of graphite or zirconium oxychloride[22] as a mold wash reduced the amount of pinholing and contamination but, for practical purposes, the reduction was negligible.

Mold additives such as the silicofluorides of ammonium, potassium, or sodium, or the borofluorides of ammonium or potassium were used also to inhibit mold reaction.[21] Some of the mold additives were more effective than mold washes in reducing mold reaction. This reduction, however, was also negligible in comparison with the results obtained with machined graphite molds. The research at Battelle showed that the best refractory oxide shell mold with regard to surface finish was made from electrically fused alumina to which 1/2 weight per cent of magnesium silicofluoride was added.

The research at Battelle also showed that shell molds composed of coarse graphite powder bonded with 12 weight per cent phenol formaldehyde were somewhat better than the refractory oxide shell molds.[9] Castings with good surface finish on sections up to 2 in. in thickness were cast in graphite shell molds. However, the depth of contamination of castings from graphite shell molds was only slightly less than that of castings from refractory oxide shell molds.

The contamination depth from various shell molds, as indicated by hardness traverses, is shown in Fig. 4 and 5.[21] The hardness increase is a measure of the severity or degree of contamination. The curves in these figures show that the severity and depth of contamination is much less in machined graphite than in shell molds.

Armour has also investigated the use of shell molds for titanium castings.[17] Zircon shell molds washed with graphite were used to cast titanium valve bodies, seating rings and disks, pipe tees and ells. A fairly good surface finish was obtained.

Armour did a considerable amount of work on the gating of valves for pipe fittings. The best results were obtained when the castings were gated from the bottom. It was found necessary to provide numerous vents in the mold so that the mold could be filled rapidly. The vents were located so that they did not freeze off before the mold was completely full.

Baked Refractory Molds

Before using zircon shell molds, Armour investigated a wide variety of baked sand molding mixtures for casting titanium valve bodies.[17] Their best molding mixture had the following composition:

1 per cent core oil
5-3/4 per cent silica flour
1-3/4 per cent pitch
2-3/4 per cent royal binder
1/2 per cent cereal binder
3-1/2 per cent water
Balance—silica sand

Molds prepared from this mixture were washed with graphite and baked at 350 F just before casting. The molds were not so permeable as shell molds, and considerable difficulty was encountered with entrapped gas and blow holes in the castings.

The use of baked sand molds also was investigated at the U. S. Naval Ordnance Test Station.[23] Silica sand and zircon sand were used as mold materials and alumina, magnesia, and graphite were used as mold washes. The best molds were made of zircon washed with graphite. The composition of the molding mixture was as follows:

4 per cent Lion binder
3 per cent water
Balance—200-mesh zircon sand

Titanium castings prepared by the Naval Ordnance Test Station also were contaminated and rough because of mold reaction.

A small amount of work was conducted at Battelle[24] to reduce the amount of contamination in castings from expendable graphite molds. This work indicated that contamination could be minimized by reducing the amount of binder or by using a binder that does not contain nitrogen or oxygen. Although castings were produced with very little contamination in expendable molds of this type, further work must be done on the development of the molds so that the castings will accurately reproduce the pattern.

Weber, et al.,[15] of the Aeronautical Research Laboratory of Wright-Patterson Air Force Base, Ohio, have suggested that a mixture of zirconia plus 6.45 per cent of titanium metal powder might be satisfactory as a mold material for casting titanium. They believed that the addition of titanium metal

forms a substitutional solid solution with the zirconia. This results in an oxygen-deficient zirconia lattice that is more inert to attack by molten titanium. With this material made into a crucible for containing molten titanium, contamination of the melt was low when the melt was not superheated and holding time in the molten stage was short. However, since superheated melts would be required for casting purposes, such melts prepared in this crucible material in all probability would be contaminated.

As a mold material for casting titanium, the inertness of the zirconia-titanium material may be much greater than that for oxide shell-molding materials. However, the procedure that would be required to manufacture a mold from it might make the material uneconomical for commercial practice. To manufacture a mold, titanium and zirconia of —325 mesh size are mixed dry, suspended in methyl alcohol, and dried at room temperature. After drying, the mixture is ball milled for 1/2-hr in a 1 N solution of hydrochloric acid. If good green strength is required for forming large molds, a 1 per cent aqueous solution of Carbose D (Wyandotte Chemical Corp.) may be added. The resulting slurry is spread over the pattern, de-aired, dried at room temperature, and baked for a short time at 212 F to remove the water. The mold is fired in a vacuum of 1/2-micron for 1 hr at a temperature of 3200 to 3400 F. After firing, the mold is ready for use.

TABLE 1. COMPOSITION OF INVESTMENT MOLD MATERIALS USED FOR MAKING TITANIUM CASTINGS

Precoating Material	Precoating Binder	Back-Up Material	Back-Up Binder
Silica	Ethyl silicate	Silica	Ethyl silicate
Silica	Ethyl silicate	Silica	Ammonium dihydrogen phosphate
Silica	Nalcoag	Silica	Ammonium dihydrogen phosphate
Silica	Nalcoag	Silica	Ethyl silicate
Zirconia	Ethyl silicate	Zirconia	Ethyl silicate
Zirconia	Zirconium nitrate	Zirconia	Zirconium nitrate
Zircon	Ethyl silicate	Zircon	Ethyl silicate
Zircon	Ethyl silicate	Sillimanite	Ethyl silicate
Sillimanite	Ethyl silicate	Sillimanite	Ethyl silicate

In addition to the elaborate procedure required to prepare the mold, there is also the problem of shrinkage during firing. It was reported that shrinkage may be 15 or 20 per cent, depending on the method of forming the mold. Shrinkage of this order might make it difficult to reproduce a mold cavity of specific dimensions. However, additional work is planned to develop the molding technique so that a mold cavity of specific dimensions may be produced.[25] Low shrinkage during final firing of the mold is to be achieved by using pulverized prefired material. The new developments may also lead to fabrication of porous shell molds. Work with this material as a crucible having a capacity of about 25 lb of titanium is also being considered.

Investment Molds

Investment molds are made by pouring a slurry of refractory oxides over an expendable pattern of wax, plastic, or frozen mercury; allowing the slurry to harden; melting out the pattern; and firing the mold at a high temperature to establish a bond. Small intricate castings can be made to accurate dimensions in investment molds. Usually these castings require little or no machining before being placed in service.

Several different types of invest-

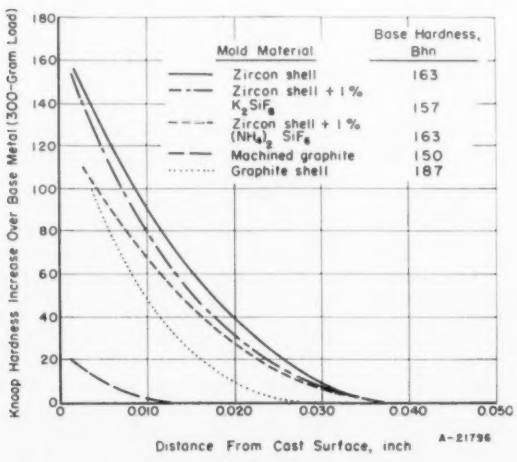

Knoop Hardness Increase Over Base Metal (300-Gram Load)
Distance From Cast Surface, inch
A-21796
Mold Material
Base Hardness, Bhn
Zircon shell 163
Zircon shell + 1% K_2SiF_6 157
Zircon shell + 1% $(NH_4)_2SiF_6$ 163
Machined graphite 150
Graphite shell 187

Fig. 4 . . Surface contamination of 1/2-in. sections of titanium in different mold materials.

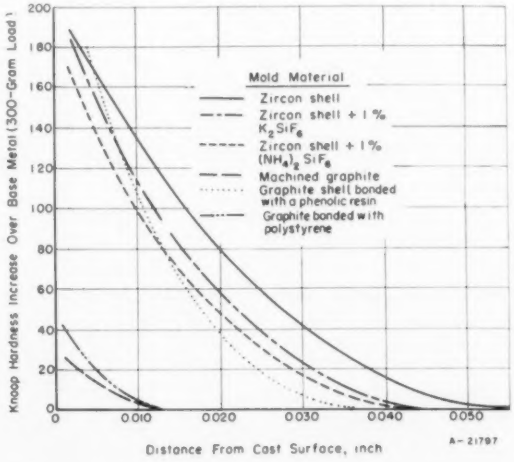

Knoop Hardness Increase Over Base Metal (300-Gram Load)
Distance From Cast Surface, inch
A-21797
Mold Material
Zircon shell
Zircon shell + 1% K_2SiF_6
Zircon shell + 1% $(NH_4)_2SiF_6$
Machined graphite
Graphite shell bonded with a phenolic resin
Graphite bonded with polystyrene

Fig. 5 . . Surface contamination of 1-in. section of titanium castings in different mold materials.

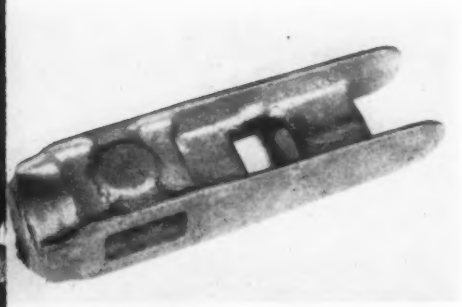


Fig. 6 . . Smooth surface was produced by investment casting.

ment mold materials for casting titanium were investigated at Battelle.[24] The mold materials were evaluated by casting small rectangular step blocks in them and rating the castings as to the surface finish, defects, and depth of contamination. Wax patterns were used for preparing all the molds.

The types of investment mold materials that were investigated in the Battelle research are presented in Table 1. Tests conducted with these various mold materials showed that the best castings were obtained when either ethyl silicate or zirconium nitrate was used as a binder for silica or zirconia investments. The surfaces of the castings made in molds bonded with Nalcoag were slightly rougher than those of castings made in molds bonded with ethyl silicate. Castings from molds bonded with ammonium dihydrogen phosphate were very rough. All of the zircon and sillimanite molds were definitely inferior to the silica and zirconia molds. When blow holes were encountered they were eliminated by increasing the permeability of the back-up investment.

The surface smoothness of titanium castings from various mold materials is shown in Table 2. These data show that the smaller sections of the castings from silica investment molds were about as smooth as those of castings made in zirconia investment molds. For the larger sections, however, the castings from silica investment molds were definitely rougher than those from zirconia molds. An intricate titanium casting made in a zirconia investment mold bonded with ethyl silicate is shown in Fig. 6. Note the good detail and smooth surfaces of this casting.

The depth of contamination was determined by making hardness traverses across transverse sections of the investment castings. All of the castings were contaminated to about the same depth as comparable section thicknesses cast in refractory oxide shell molds. The depths of contamination ranged from about 0.020 in. in the ⅛-in. sections to 0.030 to 0.040 in. in the 1-in. sections. The effect of surface contamination on the service life of the investment castings is not known.

Rem-Cru conducted a few tests on investment molds made from frozen mercury patterns.[7] The molds consisted of a precoating of zircon and a back-up investment of kyanite (Al_2SiO_5). When titanium was cast into these molds, a vigorous reaction occurred. The resulting castings were hard, brittle, and unsound. Further work on investment molds was stopped by Rem-Cru because they could not obtain sound castings.

Investment molds prepared from frozen mercury patterns by the Mercast Corp. have been used with moderate success for casting small titanium parts.[26] Data are not available on the components of the mold of the surface finish and contamination of the castings.

Proprietary Molding Processes

National Research Corp.[5] has developed an investment type of mold material that must be used with a conventional split pattern. Before casting, the molds are given a special treatment to protect them from reaction with molten titanium. The composition of the mold material has not been described, but the process is available to those who wish to license it from National Research Corp.

Castings weighing 4 to 5 lb have been made in molds produced by National Research, and the surface finish on the castings was equivalent to that of good sand castings. Hardness traverses showed that 1-in. sections were contaminated to a depth of about 0.016 in., which is slightly greater than the contamination from machined graphite molds. Compared to castings from machined graphite molds, the severity of contamination in the castings was also greater. The surface hardness of castings made by National Research was about 500 Khn as compared with about 200 Khn for castings from machined graphite molds.

E. I. du Pont de Nemours & Co.[27] has developed an expendable mold that is claimed to overcome the disadvantages of materials used by other investigators. The mold material is essentially graphite powder that is molded on the pattern at a pressure of 50 to 85 psi. The advantages claimed for molds prepared from this material are: 1) economical to manufacture because the molds can be made with existing foundry techniques, and

TABLE 2. SURFACE SMOOTHNESS OF TITANIUM CASTINGS MADE IN VARIOUS INVESTMENT MOLDS

		Surface Smoothness, rms microinches			
		Step Thickness, inch			
Mold Material	Mold Binder	⅛	¼	½	1
Zirconia	Ethyl silicate	150-170	150-170	140-160	120-150
Zirconia	Zirconium nitrate	100-120	120-140	120-150	130-160
Silica	Ethyl silicate	130-170	120-160	170-220	-- (a)

(a) Too rough to obtain a reading.

2) castings are not contaminated by the mold.

The mold composition developed by Du Pont (patent application has been filed) is as follows:

Ingredient	Amount, per cent
Electric furnace graphite powder (-20 to 100 mesh)	53
Cornstarch	10
Pitch, pulverized	10
Carbonaceous cement	8
Surface active agent[a]	1
Water	18

(a) "Duponol G" manufactured by E. I. du Pont de Nemours & Co.

Cornstarch serves as a binder to provide green strength. The surface active agent permits more thorough blending of the liquid and dry components, and reduces the amount of water that is needed. Pitch and carbonaceous cement form a high-temperature bond when the mold is fired at a temperature of 1290 to 1650 F for 1 to 2 hr.

Castings weighing from ½ to 8 lb have been made in this type mold. Some mechanical properties of a 7-lb casting of unalloyed titanium were as follows:

Ultimate strength, psi	44,500
Yield strength, psi	28,000
Elongation, per cent in 1 in.	52
Charpy impact, ft-lb	50
Hardness, Brinell	95

(Base hardness of the sponge was 95 Brinell)

Chemical analysis of the casting showed that it contained 0.06 per cent carbon, 0.004 per cent nitrogen, and 95 ppm hydrogen. These data on mechanical properties and chemical analyses indicate that good control was exercised over the melting and casting operation.

Depth of surface contamination for 1-in. sections cast in Du Pont's expendable mold was 0.040 in. as compared to 0.010 in. when cast in a machined graphite mold. There was no other evidence of surface reaction between the titanium and the mold. Sectioned castings showed a complete absence of internal porosity.

Du Pont has made castings with internal cores prepared from the expendable mold material. Again, no reaction was evident, and the cores were readily knocked out of the casting. Results of Du Pont's more recent research are described in another paper.[20]

The investment mold material used by Mercast Corp.[26] is proprietary. The available information on its suitability for casting titanium was summarized in the preceding section of this report.

TITANIUM CASTING NEEDS:

Alloys with good castability and improved technical properties

Most of the research on casting has been conducted with unalloyed titanium. The results have shown that unalloyed titanium can be cast easily into fairly complicated shapes. Castings with good surface finish and good reproduction of details can be made. Several investigators state that it is necessary to use oversize gating systems to produce sound titanium castings.[5, 17, 24, 28] However, if the melts are superheated adequately, the gating systems for titanium castings need not be any larger than those for other cast metals. Consequently, the fundamental principles for gating castings apply to titanium as well as to other metals.

Indications

Although very little work has been done on the casting of titanium alloys, there is some indication that the alpha and alpha-beta alloys have as good castability as unalloyed titanium. The alpha and alpha-beta alloys may be a little easier to cast because the metallic alloy additions usually lower the melting point and thus the melts can be superheated more easily. Castings prepared from adequately superheated melts generally are free of the cold shuts, entrapped gas, and misruns that are often encountered in titanium castings.

Rem-Cru[19] has reported that the meta-stable beta alloys such as Ti-10Mn-5Cr-5Mo are difficult to cast because they have long freezing ranges. Alloys with long freezing ranges are hard to feed and, as a result, there are shrinkage voids within the castings. Most of the alloys that have been cast were developed as wrought alloys. Experience with other metals has shown that wrought alloys are not always adaptable to the casting process.

Research has been done on the development of Ti-Al, Ti-Si, and Ti-Al-Si casting alloys at Frankford Arsenal.[29, 30, 31] The work was concerned mainly with the mechanical properties of the cast alloys. Armour[17] also did some research on casting alloys, but the main objectives were to improve the fluidity of the melts and to improve the machinability of the castings which were contaminated with carbon. Good surface finishes were obtained on castings made from Ti-Fe, Ti-Fe-V, and Ti-Si alloys, but the Ti-Si alloys were difficult to machine. Most of the work was conducted with a Ti-1.2 Fe-0.8V alloy because it had better casting properties and was easier to machine than most of the other alloys tested.

Rem-Cru[32] has conducted a detailed investigation of the casting properties of titanium and the alloys Ti-4Al-4Mn, Ti-7Al, and Ti-7Mn. The melts were prepared in a fixed-electrode, skull-melting fur-

nace and cast into graphite ingot molds. One-half of each ingot was used for determining the as-cast properties of the alloy, and the other half was forged, rolled, and annealed to determine the wrought properties. The results of these tests are summarized in Table 1. In general, the properties of the material were higher in the wrought condition than in the as-cast condition.

The mechanical properties of some other cast titanium alloys are presented in Table 2. Of these, the Ti-7Al-3Mo and the Ti-Al-Si types appear to have an interesting combination of properties.

TABLE 1. AS-CAST VERSUS WROUGHT PROPERTIES OF FOUR DIFFERENT TITANIUM ALLOYS [32]

Alloy	Ultimate Strength, 1000 psi		Elongation, per cent in 1 inch		Impact Strength, ft-lb	
	As—Cast	Wrought	As—Cast	Wrought	As—Cast	Wrought
Unalloyed	54-62	75	25-35	29-32	62-99	51-72
Unalloyed	54-60	66-70	31-35	27-32	32-97	85-93
Unalloyed	87-90	95-96	6-11	26-28	12-15	26-31
Ti-4Al-4Mn	128-133	157-159	9-14	17-18	12-20	15-18
Ti-4Al-4Mn	125-129	147-150	3-4	17-18	3-4	8-8.5
Ti-4Al-4Mn	120-125	150	7-13	17-18	12-19	18-21
Ti-7Al	118-135	150-152	1-6	11-14	8-12	9-10
Ti-7Al	111-117	132	7-18	12-15	25-31	20-35
Ti-7Mn	109-137	132	1-2	22-23	3	13.5
Ti-7Mn	117-135	136-146	--	12-17	2.5	3-6.5
Ti-7Mn	100-121	126-128	1-8	23-26	5-6	16-21

Design

Little research has been done on the design of titanium castings. However, there is nothing to indicate that the fundamental principles of good casting design do not apply to titanium. Except for its reactivity, titanium behaves like any other molten metal.

If uncontaminated castings from machined graphite molds are required, they should be designed as simply as possible to minimize the cost. Complex machined graphite molds are expensive and have a relatively short life.

Another way of producing castings without surface contamination is to cast them oversize in expendable oxide molds and remove the contaminated surface by pickling. Battelle[24] used a pickle solution containing 50 parts of sulfuric acid by volume in 50 parts of water with an addition of 25 grams of ammonium bifluoride per liter of solution. The surface of castings immersed in this solution is removed uniformly regardless of the severity of contamination, and there is no loss of detail in the castings. The rate of surface removal with this pickling solution is about 0.015 in./hr when the solution is maintained at 120 F. With this pickling solution, there is some hydrogen absorption by the titanium that might affect the mechanical properties unless the casting is vacuum annealed.

To avoid hydrogen embrittlement, a pickling solution containing 20 to 60 weight per cent nitric acid and 2 per cent hydrofluoric acid is recommended by Rem-Cru.[35] The pickling bath is maintained at 150 F, and the nitric acid content must be maintained at 20 per cent or greater to minimize hydrogen pick up.

TABLE 2. MECHANICAL PROPERTIES OF EXPERIMENTAL TITANIUM ALLOYS CAST IN MACHINED GRAPHITE MOLDS
(Except where noted, all melts were prepared in fixed-electrode, skull-melting furnaces)

Alloy	Yield Strength, 1000 psi	Tensile Strength, 1000 psi	Elongation, per cent	Reduction of Area, per cent	Hardness, Bhn	Impact Strength, ft-lb	Reference
Unalloyed	31	48	38	50	111	66	30
Ti-4Al	80	91	14	14	223	60	29
Ti-6Al	107	116	10	26	255	42	29
Ti-7Al	103	108	11	26	259	53	29
Ti-0.25C	66	90	9	11	182	11	1
Ti-0.7C	81	91	2.5	1.5	217	2.5	1
Ti-2Fe[a]	--	105	2.6	--	--	--	17
Ti-0.1Si	52	64	32	65	143	23	30
Ti-0.2Si	51	68	32	60	143	22	30
Ti-0.9Si	76	89	17	29	192	38	30
Ti-1.8Si	98	104	1.5	3	229	5	30
Ti-3Si	69	74	0.07	0.25	235	2	30
Ti-4Al-0.1Si	80	93	14.5	29	212	57	31
Ti-4Al-0.5Si	95	108	12	25	245	38	31
Ti-4Al-1Si	116	122	9.5	23	273	--	31
Ti-6Al-0.1Si	105	112	11	21	248	43	31
Ti-6Al-0.5Si	119	126	9.5	21	277	28	31
Ti-6Al-4V[b]	129	137	7	17.6	--	--	33
Ti-6Al-1Si	139	146	7.5	17	305	14	31
Ti-7Al-3Mo[b]	120	136	10	12.4	--	--	33
Ti-4Al-4Mn	140	149	5	9	--	6	34
Ti-4Cr-2Mo	101	124	11	15	--	12	5

[a] Melted in a graphite-lined induction furnace. Carbon content was 0.78 per cent.

[b] Melted in a skull furnace with a consumable electrode.

Alloy tested in heat-treated condition, but heat treatment is not known.

THE NEXT TEN YEARS for TITANIUM CASTINGS

Missile, ordnance, marine applications and chemical industries offer market for castings

The largest potential markets for titanium castings exist not in the aircraft industry, but in missile, ordnance, and marine applications and in the chemical process industry. Immediate applications probably could be found in the aircraft and missile industry since a premium price may be justifiable there. The bulk of the market is expected to develop in other areas when the price of quality castings is reduced substantially.

Estimates of the potential market for titanium castings in aircraft range from 25 to 200 lb per plane. Based upon production of 10,000 planes per year and an assumption of only 25 lb of castings per plane, the annual demand for titanium castings would amount to 125 tons, or about 2-1/2 per cent of the estimated production of titanium mill products in 1956. Some of the titanium castings of interest to the aircraft and missile manufacturers are: pipe fittings; valve bodies and trim; clamps; bearing housing and supports; hinges and brackets; jet engine compressor blades, vanes, disks, and spacer rings; bell cranks; elevator torque fittings; spar fins; missile bulkheads.

The potential market for titanium castings in the chemical process industry is greater than that of the aircraft industry. In the chemical process industry, a material with the excellent corrosion resistance, strength, and ductility of titanium fills a vital need. Fabricated titanium parts have already shown their marked superiority over other materials when used for handling corrosive liquids and gases. The added cost of the titanium parts is more than offset by the savings realized in less frequent downtime.

Other important markets for titanium castings exist in marine and ordnance applications. The Navy is quite interested in titanium castings because of its resistance to corrosion by sea water. In marine applications, titanium castings can be used for hardware, pipe fittings, valves, pump impellers and bodies, and pinions. For ordnance applications, titanium castings are desirable in mobile and airborne equipment where high strength and light weight are desirable.

When a thriving titanium casting industry becomes established, it is estimated that the annual demand for castings would amount to about 10 per cent of the annual production of titanium sponge. Present trends indicate that sponge production may reach an annual rate of 35,000 tons by 1959.[36] If a casting industry were to be firmly established at that time, the potential market for castings might then be 3,500 tons.

Commercial Availability

At the present time, the only industrial organizations known to have an active interest in making titanium castings are:

National Research Corp., Cambridge, Mass.

Titanium Casting Corp., Division of Howard Foundry Co., Chicago

Wisconsin Centrifugal Foundry, Inc., Waukesha, Wis.

Crane Co., Chicago

Oregon Metallurgical Corp., Albany, Ore.

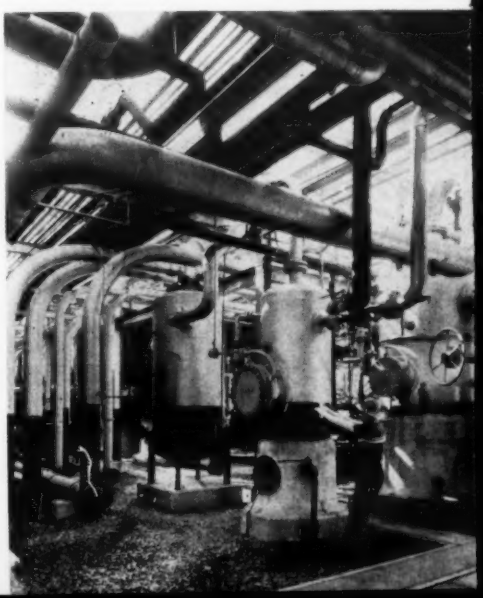
National Research Corporation produces pilot quantities of experimental castings. A fixed-electrode, skull-melting furnace and an undisclosed investment type of mold material are used. Both were developed by National Research Corp. Titanium Casting Corp. uses a furnace built by National Research and has also licensed the National Research Corp. molding process. The Wisconsin firm has centrifugally cast titanium rings and sleeves up to 5 in. diameter that weigh up to 9 lb. The castings are made in machined graphite molds. The skull furnace used for melting is of the fixed electrode type.

The Crane Co. is producing castings on a very limited basis by induction melting techniques. The castings have low ductility because of carbon contamination from the graphite-lined crucible. The Oregon Metallurgical Corp. melts a consumable electrode under vacuum in a skull furnace and lip pours the melt into machined graphite molds.

Immediate Needs For Growth

Analysis of available data on the casting of titanium indicates that further research should be conducted on the development of ex-

Chemical industry requirements promise commercial market for producers of titanium castings.



pendable molds that do not contaminate the castings. Development of an inert, inexpensive mold material would provide a strong impetus to the growth of a titanium casting industry.

An investigation also should be made to determine the effect of surface contamination on the service life of titanium castings. If surface contamination is not a problem in some applications, many of the mold materials with which foundrymen are familiar may be adapted to the casting of titanium.

Further research should be conducted on the development of titanium casting alloys because wrought alloys with good mechanical properties are not necessarily good casting alloys. Thus, much of the work that has been done on the development of wrought titanium alloys will give no indication of their suitability as casting alloys.

The development of casting alloys that can be heat-treated to develop higher strength with adequate ductility is also desirable. Alloys with an ultimate tensile strength of 130,000 to 180,000 psi and a minimum elongation of 5 per cent are desired.

This article is based on a paper' "*Status of Technology for Casting Titanium*," which was presented at a Light Metals Session of the 1957 AFS Casting Congress.

ACKNOWLEDGMENT

The information, data, and photographs presented in this Bonus Section were correlated on the Titanium Metallurgical Laboratory Project at Battelle, AF 18(600)-1375, from the literature, from reports filed in the Information Center of the TML, and from various companies and government agencies either by visit or correspondence. The cooperation of these organizations, especially listed below, is gratefully acknowledged: Crane Co.; E. I. du Pont de Nemours & Co., Inc.; Frankford Arsenal; National Research Corp.; Oregon Metallurgical Corp.; Titanium Casting Corp., Division of Howard Foundry Co.; United States Bureau of Mines, Albany, Ore.; Wisconsin Centrifugal Foundry.

REFERENCES

(1) Simmons, O. W., and Edelman, R. E., "Mechanical Properties of Cast Titanium-Carbon Alloys", TRANSACTIONS, American Foundrymen's Society, v 61, 1953, pp 411-415.

(2) Beall, R. A., Wood, F. W., and Roberson, A. H., "Large Titanium Castings Produced Successfully", *Journal of Metals*, v 7, July, 1955, pp 801-804.

(3) Beall, R. A., Wood, F. W., Borg, J. O., and Gilbert, H. L., "Production of Titanium Castings", U.S. Department of the Interior, Bureau of Mines Report of Investigation 5265 (August, 1956).

(4) Unpublished data supplied by S. M. Shelton, Oregon Metallurgical Corp., Albany, Ore. (Jan. 18, 1957; Feb. 5, 1957).

(5) Sinizer, D. I., and Adams, C. M., "Titanium Casting Metallurgy and Production Techniques", **American Foundryman*, v 27, June, 1955, pp 85-89.

(6) "The Rehabilitation and Operation of a 100-Pound, Tilt-Pour, Skull, Arc Melting Furnace", Interim Technical Report No. 2, Contract No. DA-19-059-ORD-188, Rem-Cru Titanium, Inc., Watertown Arsenal (1953).

(7) "To Conduct Research In and Promote Development of Titanium Castings for Ordnance Applications", Final Report, Contract No. DA-19-059-ORD-188, Rem-Cru Titanium, Inc., Watertown Arsenal (May 14, 1953).

(8) Simmons, O. W., McCurdy, H. R., and Edelman, R. E., "A Bottom-Pour Arc Furnace for Melting and Casting Titanium", TRANSACTIONS, American Foundrymen's Society, v 62, 1954, pp 528-532.

(9) Lang, R. M., Gissy, J. L., Schippereit, G. H., and Kura, J. G., "Expendable Molds for Titanium Castings", TRANSACTIONS, American Foundrymen's Society, v 62, 1954, pp 517-522.

(10) Brace, P. H., "Induction Melting and Casting of Titanium Alloys", *Metal Progress*, v 55, 1949, pp 196-197.

(11) Eastwood, L. W., and Craighead, L. W., "Refractories for Melting Titanium", AF Technical Report No. 6218, Part 1, Contract No. AF 33(038)-3736, Battelle Memorial Institute, Air Material Command, WPAFB (June, 1950).

(12) Chapin, E. J., and Friske, H. W., "A Metallurgical Evaluation of Refractory Compounds for Containing Molten Titanium—Borides and Sulfides", Naval Research Laboratory (Jan. 17, 1955).

(13) Eisenberg, M., and Stavrolakis, J., "Investigation of Refractories Suitable for Melting Titanium and Its Alloys", WADC Technical Report 53-91, Contract No. AF 33(038)-23280, Armour Research Foundation, Wright Air Development Center (July, 1953).

(14) Scheffer, K. D., McMurtry, C. H., Burdick, R. B., Crandall, W. B., "Exploratory Research in the Field of Container Materials for Titanium", WAL Report No. 13, Contract No. DA-30-115-ORD-498, Project TB 4-15, Alfred University, Watertown Arsenal (Jan. 31, 1955).

(15) Weber, B. C., Thompson, W. M., Bielstein, H. O., and Schwartz, M. A., "Ceramic Crucible for Melting Titanium", WADC Technical Report 56-372, ASTIA Document No. AD 97285, Project 7350, Task 70634 (September, 1956).

(16) Lang, R. M., Kura, J. G., and Jackson, J. H., "Evaluation of Mold Materials for Titanium Castings", TRANSACTIONS, American Foundrymen's Society, v 61, 1953, 540-545.

(17) Glassenberg, M., and Berger, M. J., "Producing Titanium Alloy Castings", TRANSACTIONS, American Foundrymen's Society, v 62, 1954, pp 375-380.

(18) Ahern, P. J., and Frey, C. F., "Induction Melting of Titanium", *Metal Progress*, v 70, October, 1956, p 112.

(19) "The Skull Furnace, Pouring and Casting of Titanium Shapes and Their Properties", Interim Technical Report No. 3, Contract No. DA-19-049-ORD-188, Rem-Cru Titanium, Inc., Watertown Arsenal (1953).

(20) Feild, A. L., Jr., and Edelman, R. E., "The Use of Expendable Graphite Molds in the Production of Sound, Ductile Titanium Castings", MODERN CASTINGS, v 31, May, 1957, pp 64-68.

(21) Gissy, J. L., Lang, R. M., Schippereit, G. H., and Kura, J. G., "Surface Contamination and Bend Ductility of Titanium Castings", TRANSACTIONS, American Foundrymen's Society, v 62, 1954, pp 523-527.

(22) Lang, R. M., "Shell Molds for Titanium Castings", **American Foundryman*, v 25, March, 1954, pp 60-62.

(23) LaBosky, J. B., and Veronda, D., "A Technique for Sand Casting Titanium and Titanium Alloys", U.S. Naval Ordnance Test Station, Inyokern, T.M. 770 (July 10, 1953).

(24) "Development of Processes for Making Titanium Castings Other Than Ingots", Summary Report, Contract No. DA-33-019-ORD-223, Battelle Memorial Institute, Frankford Arsenal (March 31, 1954).

(25) Letter to J. G. Kura from B. C. Weber of Wright-Paterson Air Force Base, dated Jan. 15, 1957.

(26) Kramer, I. R., "Investment Casting by the Frozen Mercury Process", TRANSACTIONS, American Foundrymen's Society, v 62, 1954, pp 445-447.

(27) Feild, A. L., Jr., "Expendable Molds for Titanium Castings", *Metal Progress*, Oct., 1956, pp 92-96.

(28) Edelman, R. E., "Melting and Casting of Titanium", Lecture No. 5, One-Week Course in Titanium Metallurgy, sponsored by Department of Metallurgical Engineering, College of Engineering, New York University and Office of Special Services to Business and Industry (Sept. 10-14, 1956).

(29) Edelman, R. E., and Tabak, A., "Mechanical Properties of Cast Titanium-Aluminum Alloys", TRANSACTIONS, American Foundrymen's Society, v 62, 1954, pp 304-307.

(30) Antes, H. W., and Edelman, R. E., "Mechanical Properties of Cast Titanium-Silicon Alloys", TRANSACTIONS, American Foundrymen's Society v 63, 1955, pp 662-668.

(31) Antes, H. W., and Edelman, R. E., "Cast Titanium - Aluminum - Silicon Alloys", *Foundry*, v 83, July, 1955, pp 92-95.

(32) "Continued Research and Development of Titanium Castings", Final Technical Report, Contract No. DA-19-059-ORD-1520, Rem-Cru Titanium, Inc., Watertown Arsenal (1954).

(33) Unpublished data supplied by J. Ryan, Wisconsin Centrifugal Foundry, Waukesha, Wis. (Oct. 1, 1956).

(34) Malone, R. F., Clark, H. T., Arnold, S. V., and Finlay, W. L., "Preliminary Survey of Some Metallurgical Bases for a Titanium Castings Industry", TRANSACTIONS, American Foundrymen's Society, v 61, 1953, pp 673-685.

(35) "Acid Pickling Without Hydrogen Embrittlement", *Rem-Cru Titanium Review*, v 2, October, 1954, p 7.

(36) Kellogg, H. H., "Symposium on Titanium —I. Sponge and Mill Production Economies", *Journal of Metals*, v 9 January 1957, pp 161-166.

* now MODERN CASTINGS

LEAKING AIR INFLATES COST

Sizable savings will result from periodic checking of complete air system

CHARLES BRIWA / *Compressed Air & Gas Institute, Cleveland*

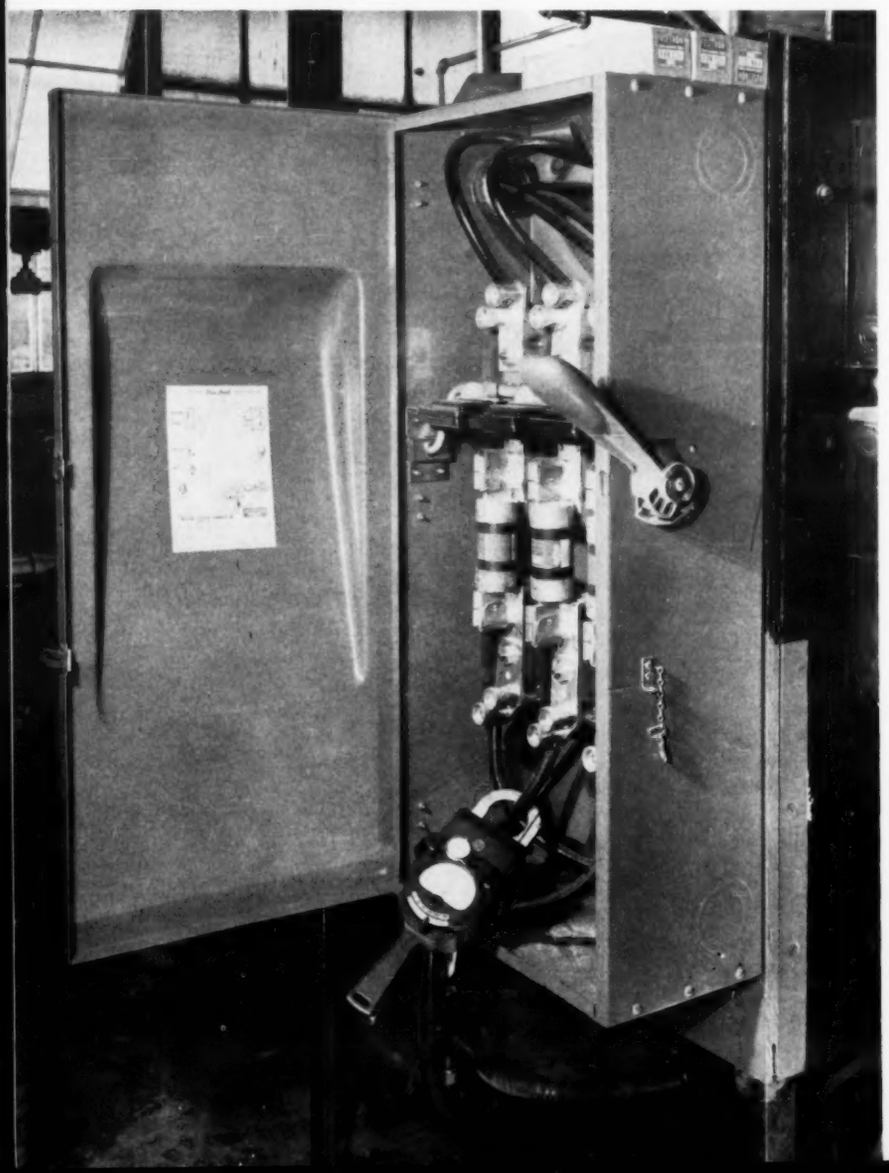
Is that insidious villain, leaking air, hissing away your operating dollars? Since no one has to mop up puddles of leaking compressed air, its plea for attention is too often ignored by maintenance men. The modern compressed air system is a myriad of pipes, fittings, valves, hoses, and tubes. Unfortunately, each component of the system is subject to leakage. And again, unfortunately, the evidence is not as messy as leaking fluids. The subtle nature of the leakage promotes a lax attitude among the most responsible people.

Water, oil, or steam leaks that may develop about the plant are quickly and carefully repaired. Yet anything short of a major break in the compressed air system will go unrepaired for a long period of time. The following paragraphs present a simple and effective method of determining the cost of your compressed air leakage. Necessity of good leakage control will be apparent.

Check at Off-Hour

Varied uses of compressed air and the uncertain quantity of uses make it practically impossible to determine leakage (and hence its cost) during hours when compressed air is being consumed usefully. If possible, select a time when useful consumption of compressed air is zero, and hence the total output of compression is lost to leakage. This time may well be during an off-shift, holiday, or other idle period. For the most accurate results be certain that *no compressed air is being used usefully.*

If you cannot select a time when use of compressed air is zero, the



Testing equipment, although simple, is effective and inexpensive.

Sample Data Sheet

Test by_____ Date_____

Compressor Test to Determine Power Used to Maintain Working Pressure of an Idle Compressed Air System.

Time of Day	Cycle	Duration	Volts	Amps.
10:30	Idle	5 min.	232	67
10:35	Load	1 min.	227	180
10:36	Idle	6 min.	232	67
10:42	Load	1 min.	227	180
10:43	Idle	5 min.	232	67
10:48	Load	1 min.	227	180
10:49	Idle	5 min.	232	67
10:54	Load	1 min.	227	180
10:55	Idle	5 min.	232	67
11:00	Load	1 min.	227	180
11:01	Idle	6 min.	232	67
11:07	Load	1 min.	227	180
11:08	Idle	5 min.	232	67
11:13	Load	1 min.	227	180
11:14	Idle	5 min.	232	67
11:19	Load	1 min.	227	180
11:20	Idle	6 min.	232	67
11:26	Load	1 min.	227	180
11:27	Idle	5 min.	232	67

Total Load Time in One Hour - 9 minutes
Total Idle Time in One Hour - 51 minutes

Machine #_____

Motor Name Plate Data:

Westinghouse Induction Motor
75 horsepower - 220/440 Volts - 185/92 amps
870 R.P.M. Full Load

next best thing is to choose a period when use is at a minimum. In this case, the quantity used usefully must be determined. A correction factor must then be applied to the total, producing a synthetic figure similar to that mentioned earlier—i.e., the compressed air supplied to maintain working pressure of the idle system. Obviously, this quantity is air leakage and the cost of this quantity is the cost of air losses. To determine the actual number of cubic feet being wasted may be of academic interest; however, this knowledge leads to an important figure—the leakage price tag.

In order to calculate cost of electricity, power consumption by the air compressor is best measured by a recording watt-hour meter. However, instruments of this type are not usually available. For this reason the following method is offered.

Obtain a watch, voltmeter, ammeter, and data sheet. The clamp-on combination-type meter is recommended. Necessity of working with an energized circuit requires caution in taking readings. Total running time of the compressor is measured and recorded. In the case of the constant running machine, loaded and idle time are the significant values. Voltage and current during each cycle must also be measured and recorded.

Test Takes Minutes

Most of the readings will be repetitive in nature and the test will quickly resolve itself into a standard routine. With a few minutes practice, one man can easily take the readings and record the data.

Length of the test should be at least one to two hours. The test should be made at two or three different periods (perhaps weekly) to assure accurate sampling. Once the data is collected, it is easily converted to terms of power and projected into weekly or monthly figures. Equations and sample calculations for a three-phase induction motor are given in the following sample calculation:

For three phase power:

$$Kw = \frac{EI\ 1.73\ \text{Cos.}\ \theta}{1000}$$

Where: E = Voltage in Volts
Where: I = Current in Amps
Cos. θ = Power factor in decimal form.

From the data sheet:

Idle E = 232
Idle I = 67
Assume Cos. θ = .55

$$Kw = \frac{(232)\ (67)\ (173)\ (.55)}{1000} = 14.78$$

Loaded E = 227
Loaded I = 180
Assume Cos. θ = .80

$$Kw = \frac{(227)\ (180)\ (1.73)\ (.80)}{1000} = 56.55$$

And:

Loaded KW — IDLE Kw = NET LOSS Kw 56.55 — 14.78 = 41.77 Kw

9 min. per hour = 9/60 = .15 hr per hr

Assume:

The compressor runs 18 hours, 22 days per month. Power cost 2¢ per Kw-hr

Therefore:

(Days of operation) × (Hours Day) × (Loaded time for losses per hr.) × (Net Loss Kw) × (Cost Per Kw Hr.) = COST OF THE LOSSES PER MONTH

And:

22 × 18 × .15 × 41.77 × .02 = $41.30.

If another type motor drives your compressor, your calculations will be similar but not exactly the same. The sole remaining unknown is power cost and this is readily available from your electric bills.

At this point the author wishes to raise a question of economics and suggest that the no-load efficiency of the air compressor be applied to reduce the cost of leakage. The cost of inherent inefficiencies of idle running air compressors must be charged to the cost of supplying compressed air for useful purposes and not for leakage. This is not entirely true if working pressure is maintained on the idle compressed air system. In this case, inefficiencies must be charged to leakage during the idle period.

Most Systems Aren't Idle

Do not be confused on this point; very few idle systems are maintained at working pressure. Among thousands of compressed air uses, many are perpetual. Although regular shifts of production people are off, compressed air may be performing some noteworthy and necessary tasks.

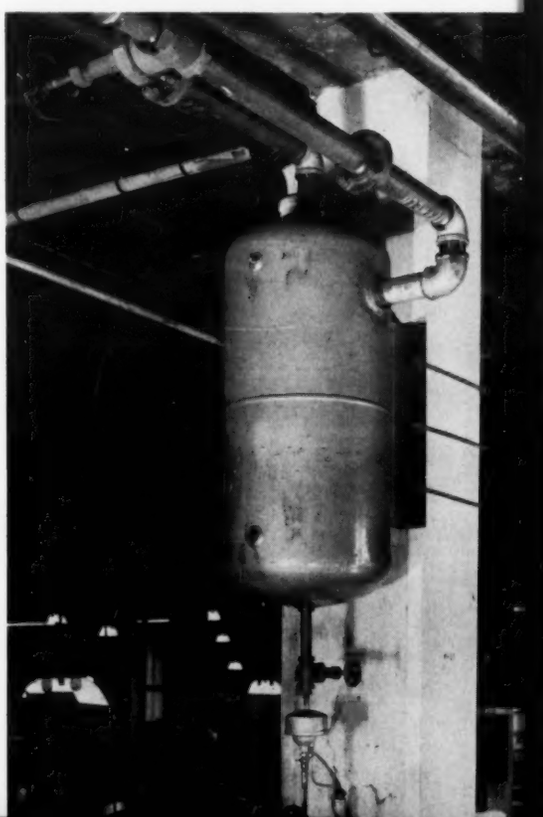
Once you have test results computed into terms of dollars, the remaining job is to seek out and eliminate waste. Large leaks are easily found audibly, but smaller ones are best located by painting a soap solution around suspicious joints. Without a doubt elimination of leaks will be rewarded by a sizable saving, and an increase in the useful capacity of your compressor equal to the losses eliminated.

TEN COMMON COMPRESSED AIR LOSSES

1. Faulty blow gun valves.
2. Faulty air hoses.
3. Drip valves left open to prevent the collection of condensate.
4. Poorly packed valve stems.
5. Faulty air operated equipment.
6. Poorly made or loose swing joints.
7. Faulty check valves.
8. Stretched or out-of-round pipe fittings or valves.
9. Cracked, broken or porous valve bodys or fittings.
10. Cracked or porous pipe.

Small leaks are best found by applying soap solution.

Automatic drains prevent condensation in receivers.



where the Nittany Lion roars . . .

260 FOUNDRYMEN ATTEND 1st PENN STATE MEET

J. H. Schaum / *Editor*

Practically every facet of the latest foundry technology was covered in a program designed to provide worthwhile information and discussions for the operating foundryman—the "man in the shop" directly responsible for foundry operations. To achieve this goal at the first Penn State Foundry Conference, 26 top men of the castings industry covered the fields of gray iron, malleable iron, steel, nonferrous, sand and mechanization to the satisfaction of over 260 who attended.

This conference, June 20-22, was the first of its kind to be held on the picturesque, 3627-acre Pennsylvania State University campus.

In the colorful ballroom of the Hetzel Union Building, James H. Smith, general manager of the Central Foundry Division, GMC, spoke at the conference banquet about the "American Foundryman, 1957 Model —with his vital interest and practical concern with new processes and methods in industry as well as his impact upon the American way of life." Concerning automation, Mr. Smith said that "automation stands for plentiful production and is our great hope for military and economic security as we look to the future."

Two banquets on successive evenings were required to provide appearance time for the many notables on the agenda. Merritt A. Williamson, dean, College of Engineering and Architecture, The Pennsylvania State University, spoke on "Words and Reality." Dr. Albert F. Buffington, professor of German at the university, acquainted the foundrymen with "Pennsylvania Dutch Humor."

AFS President, Harry W. Dietert, described the new educational program of the AFS Training & Research Institute. Foundry Educational Foundation President, Chester V. Nass, spoke about F.E.F. activities at the university. Past President of the Foundry Equipment Manufacturers' Association, Thomas Kaveny, Jr., talked on behalf of F.E.M.A.. The banquets were ably toastmastered by Conference Chairman W. B. Wallis, Lectromelt Furnace Div., McGraw Edison Co., and Conference Vice-Chairman C. W. Mooney, Link-Belt Co. The conference success was largely due to the efforts of these two men and Conference Secretary W. P. Winter, professor at the university, Conference Treasurer H. P. Good, Textile Machine Works, and Conference Program Chairman E. J. Biller, Vulcan Mold and Iron Co.

"Automation . . is our great hope," banquet speaker James H. Smith told the conferees.

The technical talks presented at the conference are briefly summarized below. Some of the talks will be published in future issues of Modern Castings in abstract form or in their entirety. Complete copies of most of these papers can be obtained for a nominal fee to cover cost of reproduction, by writing to Modern Castings, Golf and Wolf Roads, Des Plaines, Ill.

■ Steel

Presiding — R. H. English, Blaw-Knox Co. and R. W. Zillman, Pittsburgh Steel Foundry Corp.

Frank H. Dettore, G. E. Smith Co., described the use of Swiss Skatt process of cold setting oil binders in steel foundries. In this process high-grade silica sand is mixed for 3 minutes with 15 per cent oil binder and 0.1 per cent activator. Setting starts approximately 30 minutes after mixing.

A three-man panel led discussion of the CO_2 process for steel cores. The three experts, R. W. Zillman, Pittsburgh Steel Foundry Corp., James W. Hamblen, National Cylinder Gas Co., and R. H. English, Blaw-Knox Co. discussed solutions to the problems of collapsability, shakeout, and hot sagging.

F. W. Less, Durez Plastics Div., Hooker Electrochemical Co., gave a report on "Shell Molding of Steel Castings." He advised steel founders to use as coarse a sand as commensurate with the "as cast" finish required on the casting.

Frank Youngworth, Foundry & Mill Machinery Div., Blaw-Knox Co., presented "Sand Control for Green Sand Practice in Steel Foundry." Rigid control of foundry sand mixes through an efficiently operated sand system will do a lot toward producing quality castings at minimum cost.

R. L. McIlvaine, National Engineering Co., presented a talk on "Sand Reclamation for the Steel Foundry." The talk was illustrated with slides depicting the removal of surface contamination from sand grains by pneumatic scrubbing. Examples of the use of reclaimed sand for cores and facing were cited.

David C. Ekey, Lebanon Steel Foundry, traced "Recent Developments in Molding in the Steel Foundry." Emphasis was placed on the various mechanical molding machines available today. The trend toward their use was revealed by the fact that 10,000 molding machines have been installed in U.S. foundries since 1949 and 63 per cent of all power molding machines in use today are less than 10 years old.

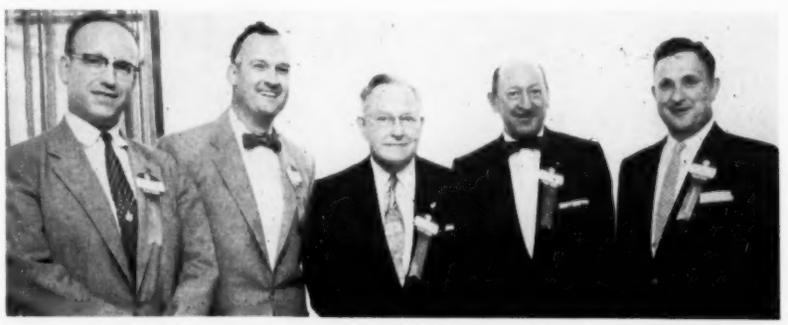
F. E. Van Voris, Electro Metallurgical Div., Union Carbide Corp., reviewed "Modern Steel Melting Practice."

■ Gray Iron

Presiding—C. W. Mooney, Jr., Link-Belt Co.

Richard Meloy, Gray Iron Founders' Society, Inc., looked into his crystal ball for market predictions in his talk entitled, "The Gray Iron Foundry Industry Looks to the Future." A summary of the growth of the gray iron castings industry during the past ten years was followed by predictions of continuing growth. However, foundries must have a well-planned marketing program to sell their castings. Customers must be

Continued on page 59



Conference committeemen who planned the event were, left to right: Secretary W. P. Winter, Pennsylvania State University; Vice-Chairman C. W. Mooney, Link-Belt Co., Philadelphia; Chairman W. B. Wallis, Lectromelt Furnace Div., McGraw-Edison Co., Pittsburgh, Pa.; Treasurer H. P. Good, Textile Machine Works, Reading, Pa.; Program Chairman E. J. Biller, Vulcan Mold and Iron Co., Latrobe, Pa.

Neat work. Corn-sugar binder helps green cores slide out of the core box.

STEEL FOUNDRY SPEEDS COREMAKING

Corn-sugar binder reduces baking time and improves casting quality

EARL BEWIG / *Superintendent*

DAVID MCGOWAN / *Chemist*

St. Louis Steel Casting Inc., St. Louis

By changing coremaking practices from the use of linseed oil bond to a new corn sugar containing a catalyst, several benefits were derived in our foundry operations at St. Louis Steel Casting Inc. Corebaking time was reduced 35 to 40 per cent, baked cores gave superior performance, and steel castings were produced with smooth internal surfaces and a minimum of veining. Because the improvements appear to stem directly from inherent characteristics of the dextrose binder* used, the experience of our foundry with this material should be of general interest to other foundrymen.

Improved casting quality is important in any foundry's marketing process; it is particularly important to our foundry because we produce carbon and alloy steel castings to meet the rigid engineering needs of construction and road-building machinery as well as oil field and refinery equipment. Most of our tonnage goes into oil well drill bits, oil refinery fittings, gear blanks, propellers, and castings for the Atomic Energy Commission.

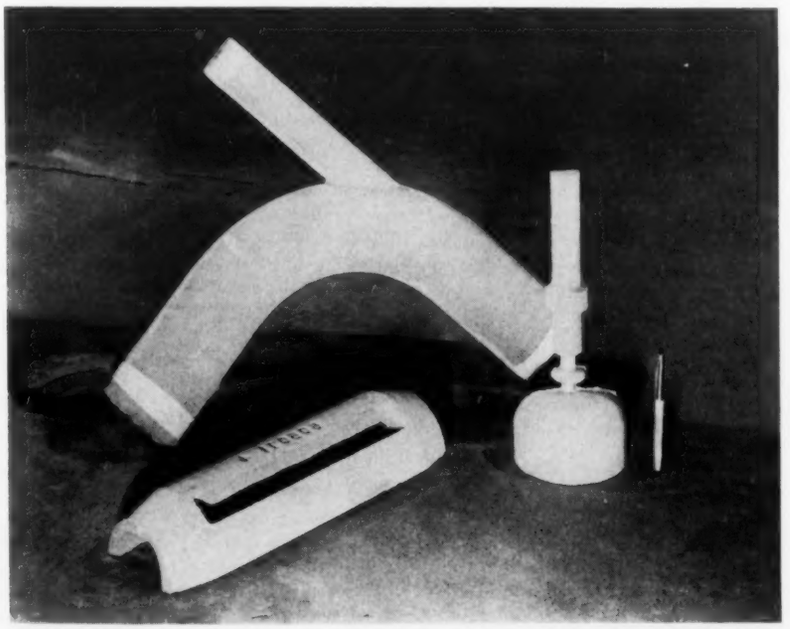
Many Binders Tested

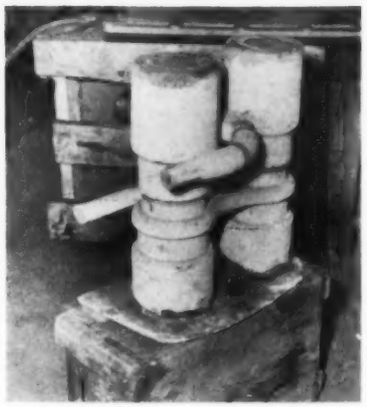
To meet the demands for closer cast tolerances and finishes we tested a number of core binder materials in our sand laboratory and subjected them to a series of plant trials under rigidly controlled conditions. The economy, fast baking, collapsibility, and improved surface finish obtained by using a new form of corn-sugar binder led to its exclusive use in the coreroom.

In form, this relatively new material is a white, water-soluble powder containing 94 per cent corn sugar and 6 per cent ammonium sulfate. The latter functions as a catalyst which converts the corn sugar into a resin-like substance during the bake. The dextrose binder is added to core sand along with cereal binder and the mixture permits ramming or blowing of green cores by usual methods. The cereal imparts green strength while dextrose supplies baked strength.

A typical core mix calls for 1500 lb of Missouri sand (58-65 AFS gfn), 18 lb (1.2% by weight) of dextrose binder, and 20 lb (1.3% by weight) of standard cereal binder. For internal coring 1% wood flour is added for collapsibility and 0.8% iron oxide for resistance to veining. Experiments were conducted with varying proportions of the mix ingredients to determine optimum combinations. These showed that the amount of cereal binder can be reduced in propor-

Quality and quantity of core production is improved by combination of good flowability and easy stripping produced by dextrose binder.





Tough jobs, such as this 450-lb, 4-6% Cr steel refinery fitting with its complex core (left), are made to order for corn-sugar binder.

tion to the amount of corn-sugar binder used. For example, if corn sugar is increased one-half per cent then cereal should be reduced one-half per cent.

Moisture Control Vital

Close control of moisture content is an important factor in the workability of the green mix and exerts a pronounced influence on the tensile strength of the baked cores. Too much water makes the mix too sticky and hot strength too high.

We normally specify a water addition of 5-½ per cent (about 7 gal of H_2O for 1500 lb batch), because in our opinion the dextrose sands need more moisture than conventional mixes. As part of the sand-control routine, moisture content of each batch of sand is determined with a precision indicator before delivery to the coremakers.

The mulling cycle is one minute dry, five minutes wet. Thorough mixing contributes in large measure to flowability. But overmulling makes mix too stiff.

Coremakers like the ready flowabilty of sands made with the dextrose binder. This characteristic prevents channeling and lumping so the sand deposits uniformly in the core box when blown. These mixes are also readily rammable. Approximately 15 to 20 per cent of cores are blown, the balance rammed with power equipment. The sand qualities facilitate attaining a uniform density no matter how complex or intricate the core.

Equally desirable, the green cores slide from boxes easily in perfect condition without sticking. Some experimenting with mix proportions and release agents was necessary before we attained the present easy stripping. Good draws are assured by increasing the moisture content and adding at or near the end of the mulling, ½-gal of release agent containing 6 to 1 mixture of kerosene and oleic acid. Both aluminum and wood core boxes stay "clean as a whistle" without any wiping necessary.

Quality and Quantity

The combination of good flowability and easy stripping has made it possible for our coremakers to improve both quality and quantity of core output. Cores made from this mixture develop exceptional green properties—2-½ to 3 psi. The dextrose binder improves plasticity of the sand and imparts superior sagging resistance. The cores hold shape regardless of stand or overhang. In cores of any shape—intricate cores, large bulky cores, or cores with a high stand—the strength properties developed with this binder have resulted in a welcome reduction in our core scrap.

It is the practice at St. Louis Steel Casting to water-spray all cores. In addition, many are swabbed with zirconite wash to resist penetration of molten steel and produce a smoother cast surface.

Baking is done in five gas-fired, batch-type ovens. An outstanding contribution of the corn-sugar binder has been a substantial reduction in time needed for baking. Some of our cores weigh as much as 300 lb. These large cores, when made in oil-bonded sands, required 6 hours of baking at 500 F. Today the same cores, in dextrose sands, bake through in 3-½ to 4 hours, at oven temperatures of 400 to 450 F. For all core sizes and weights the over-all decrease in baking time required amounts to 35 to 40 per cent as compared with oil-bonded cores.

The benefits are obvious—a reduction in fuel expense; but even more important, faster core output and improved scheduling of work in the foundry. To return to the use of oil sands, it would be necessary to install additional ovens to supply the cores now being used in our expanded operation.

Baked Core Properties

The change-over to dextrose binder has also resulted in some interesting developments in properties of the baked cores. The cores range from 85 to 95 in scratch hardness. This property is related to and parallels tensile strength. Resistance to cracking under thermal shock also shows a definite improvement.

Another side benefit noted in pouring is that the volume of gas evolved from cores prepared with the dextrose binder is less than from oil-bonded ones.

A final advantage comes from improved collapsibility of the cores made from dextrose-bonded sands. Both visual and laboratory tests established that shakeout is faster and easier, notwithstanding the solid, sturdy bonding of these cores.

Combining high baked strength and thermal shock resistance along with uniform bond and scratch hardness, these cores have practically eliminated metal penetration and, accordingly, have given smoother interiors to our castings. Reduction of casting cracking is especially noticeable in parts cast in chromium and molybdenum alloy steels. *Grinding and other repair measures are consequently minimized.*

By way of summary, properties of cores made with the catalyzed corn-sugar binder have helped us improve casting quality and appearance, as well as hold to closer dimensional tolerances despite intricate coring.

° Supplied by Corn Products Sales Co. under the trade name "Dexocor".

Inspector's light will disclose a smoother interior surface in this 800-lb refinery casting as a result of reduced metal penetration.

AFS Chapter Officers Discuss Broad Scope of Activities

Ways and means of improving service to members throughout the entire American Foundrymen's Society were suggested and analyzed at the 14th Annual AFS Chapter Officers Conference held June 13-14 at the Sherman Hotel, Chicago. Attending were 113 representatives from the Society's 46 chapters in the United States, Canada and Mexico.

AFS President Harry W. Dietert presided. He was assisted by AFS Vice-President L. H. Durdin, AFS General Manager Wm. W. Maloney, Directors, and members of the AFS staff.

President Dietert outlined the Society objectives, kept the program moving on an exact time schedule, and conducted the "shakeout" session.

Vice-President Durdin discussed the chapter contacts committee, explaining the organization and purpose of chapter contacts by National Directors—how to do it, when to do it, what to do on Director visits.

General Manager Maloney discussed nominating and electing procedures for National Directors, conventions and exhibits, finances, and how to stage regional conferences. Mr. Maloney explained how the Society is financed, its investment policy, who approves AFS expenditures, the AFS committee expense policy, and the fiscal year.

AFS Technical Director S. C. Massari spoke on AFS technical activities and the AFS Training & Research Institute, outlining the Society's purposes, aims, and plans. Dates and subject matter for the first training courses were detailed.

The safety, hygiene, and air pollution activities were explained by SH&AP Director Herbert J. Weber. The role of MODERN CASTINGS in Society activities was covered by Editor Jack H. Schaum and Advertising Manager J. M. Eckert.

A question and answer period was held after each discussion as well as a final question period at the conclusion of the two-day meeting.

Panels composed of chapter delegates discussed various chapter activities. Developing chapter programs were handled by Robert D. Dodge, *Central Michigan;* Harold R. Hirsch, *Northern California;* Lawrence A. Weaver, *Canton;* George J. Miklos, *Pittsburgh;* and Alexander Beck, *New England.*

Atom-powered electric plants were described to the officers by nuclear scientist R. E. Lapp.

Panelists on chapter membership work were Norman N. Amrhein, *Wisconsin;* Elmore C. Brown, *Texas;* Martin J. Gruhler, *Toledo;* Thomas F. Shadwick, *Mo-Kan;* and Paul Von Colditz, *Eastern Canada.*

Chapter educational programs were discussed by Emil Romans, *Northeastern Ohio;* John G. Smillie, *Quad City;* Philip M. Semler, *Michiana,* Thomas R. Walker, *Philadelphia;* and Vernon W. Rowe, *Washington.*

Special delegate meetings were held for the discussion of specific problems. Two of these concerned scheduling round-robin speakers.

Two guest speakers addressed the delegates. E. J. Walsh, Executive Director, Foundry Educational Foundation presented a report on F.E.F. developments. Dr. Ralph E. Lapp, Nuclear Science Service, Washington, D. C., was the featured speaker at the Annual Conference Dinner. His subject was "Atomic Energy Today."

Dr. Lapp had just returned from a recent trip to Japan where he had made an extensive study of the effects of radiation fall-out from the two bombs dropped during World War II. During these studies Dr. Lapp learned that over 70 per cent of the current radio-active materials dropping on Japan today are coming from nuclear weapons being tested behind the Iron Curtain.

The speaker emphasized the handicaps to generation of nuclear power by converting the heat of atomic fission into steam for operating electrical generators.

American scientists are now on the threshold of an important new breakthrough that will permit the direct utilization of atomic energy as electricity without converting heat into steam power.

Attending the conference were directors: C. E. Drury, William D. Dunn, Herbert Heaton, A. A. Hochrein, K. L. Landgrebe, R. A. Oster, F. J. Pfarr, J. R. Russo, A. M. Slichter, H. G. Stenberg, and A. V. Martens.

Others participating from the AFS Staff were A. B. Sinnett, assistant secretary; E. R. May, assistant treasurer; W. N. Davis, exhibits manager; and D. J. Hayes, field director.

113 representatives of the 46 AFS chapters assembled in Chicago to study the local and national functions of the society organization.

Technical Activities Programed by AFS Technical Council

Service Certificates were awarded for the first time to retiring division chairmen of the American Foundrymen's Society technical committees. AFS President Harry W. Dietert presented certificates to F. B. Rote, C. K. Donoho, and V. E. Zang. Absent recipients were H. C. Ahl and E. V. Blackmun.

Future technical activities of AFS were discussed and the past program reviewed by the AFS Technical Council meeting held June 4 at the Hotel Sherman, Chicago.

Annual reports were presented by eleven divisions and general interest committees represented. Council Chairman F. B. Rote, Albion Malleable Iron Co., Albion, Mich. presided.

1958 Convention

Much of the discussion centered around the 62d Castings Congress to be held May 19-23 in the Public Auditorium, Cleveland. It was agreed that requests be made to have foreign technical papers submitted in English. The authors breakfast, held daily during the convention to acquaint session chairmen, authors, and the AFS staff with the day's program, will be continued. In addition, division chairmen will be invited.

Division chairmen and vice-chairmen agreed to assume the responsibility of servicing their sessions at the 1958 Convention. Kits of materials and supplies will be made available either in advance or at the authors breakfast.

1959 Castings Show

The 1959 Castings Congress and the 2d Engineered Castings Show will be held in Chicago and will feature a castings design symposium directed toward sales and promotion of metal castings. Each division will sponsor two papers at the symposium. In addition, each division will have two representatives on a committee to coordinate activities of the technical program and exhibition.

Division Changes

The Shell Molding Committee, formerly functioning in the Light Metals Division, will be dissolved and the work of that committee assumed by the Shell Molding Committee in the Sand Division.

Plans were continued to form a Metal Mold Division by combining

activities of the Die Casting Committee and the Permanent Mold Committee.

No action was taken on the proposal to change the name of the Gray Iron Division. That division will continue its activities in the nodular iron field.

In response to an invitation from the Society of Automotive Engineers, the Technical Council agreed to participate in the writing of a casting design book.

Research Projects

Existing AFS-sponsored research projects were reviewed. It was emphasized that proposed projects must be well defined before AFS financing can be assured.

AFS training and research courses were announced. Courses covering sand testing, industrial engineering, and cupola melting will be sponsored by the AFS Training and Research Institute at Rackham Memorial, Detroit, Marquette University, Milwaukee, and University of Illinois Navy Pier, Chicago. The courses are designed for the upgrading of in-line supervision.

Those Attending

■ Those attending were:
F. B. Rote, Albion Malleable Iron Co., Albion, Mich.
B. L. Bevis, Caterpillar Tractor Co., Peoria, Ill.
W. K. Bock, National Malleable & Steel Casting Co., Cleveland.
O. C. Bueg, Arrow Pattern & Engineering Co., Erie, Pa.
R. A. Clark, Electro Metallurgical Co., Div. of Union Carbide Corp., Cleveland.
C. K. Donoho, American Cast Iron Pipe Co., Birmingham, Ala.
R. B. Fischer, Ingersoll-Rand Co., Phillipsburg, N.J.
R. J. Keeley, Ajax Metal Div., H. Kramer & Co., Philadelphia.
A. J. Kiesler, Metallurgical & Ceramics Research Dept., General Electric Co., Schenectady, N.Y.
D. L. LaVelle, Kaiser Aluminum & Chemical Sales Inc., Chicago.
J. G. Mezoff, Dow Chemical Co., Midland, Mich.
J. F. Roth, Cleveland Standard Pattern Works, Cleveland.
W. H. Ruten, Polytechnic Institute of Brooklyn, Brooklyn, N.Y.
Eric Welander, John Deere Malleable Works, East Moline, Ill.
C. E. Westover, C. E. Westover Engineers, Milwaukee.
V. E. Zang, Unitcast Corp., Toledo, Ohio.
E. C. Zirzow, Werner G. Smith, Cleveland.

■ AFS staff attending were:
H. W. Dietert, president.
Wm. W. Maloney, general manager.
S. C. Massari, technical director.
J. E. Foster, technical assistant.
A. B. Sinnett, assistant secretary.
W. N. Davis, exhibits manager.
J. H. Schaum, editor, MODERN CASTINGS.

Teachers Learn About Industry at 2d AFS Instructors Seminar

Plastic patterns and the CO_2 process will be familiar terms to vocational and high school students who enter the cast metals industry from classes taught by instructors who attended the 2d AFS Foundry Instructors Seminar sponsored by the Education Division of the American Foundrymen's Society at Michigan State University, June 20 to 22.

A demonstration of epoxy resins and plastic patterns was conducted by M. K. Young, U. S. Gypsum Co., Chicago. The demonstration was designed to be repeated by the instructors in their classrooms.

A similarly designed demonstration of the CO_2 process as applied to school laboratories was conducted by J. E. Gothridge, Foundry Services, Inc., Columbus, Ohio.

Over 85 instructors attended the three-day session. AFS Vice-President L. H. Durdin was chairman for the event.

For a picture of the metal castings industry in operation, the instructors toured the permanent mold foundry of Eaton Manufacturing Co. at Vassar, Mich.

A picture of the need for technically trained men in the castings industry was presented by W. H. Ruten, Polytechnic Institute of Brooklyn, chairman of the AFS Education Division. In-plant training in the metal castings industry was described by Paul W. Olson, Foundry Div., Eaton Manufacturing Co., Vassar, Mich.

"What Small Industry Needs in a Student," was outlined by Earl M. Strick, Erie Malleable Iron Co., Erie, Pa. B. L. Bevis, Caterpillar Tractor Co., Peoria, Ill., told *"What Large Industry Needs in a Student."*

Professional interests of the instructors were the subjects of three events on the seminar program. Norman Mitby, Green Bay Vocational and Adult School, Green Bay, Wis., presented a paper on *"Coordinating a School-Industry Program."* Robert Worthington, Assistant State Superintendent of Industrial Education, St. Paul, Minn., discussed the value of a cast metals class in a general shop program. A series of workshops gave the teachers a chance to exchange personal experiences and problems.

Other highlights of the seminar included four talks by AFS staff members. S. C. Massari, AFS technical director, discussed the latest technical and engineering advancements of the industry. Wm. W. Maloney, AFS general manager, described the AFS program and the AFS Training and Research Institute. A. B. Sinnett, AFS assistant secretary, discussed the Robert E. Kennedy Memorial Apprentice Contest, and H. J. Weber, AFS director of safety, hygiene, and air pollution control, talked on *"Common Sense of Foundry Safe Practices."*

AFS headquarters reports that plans are now underway for the 1958 seminar to be held at Case Institute of Technology, Cleveland.

Questions and Answers

Earl M. Strick ponders an answer to a question from one of the 85 vocational and high school instructors who attended the seminar.

Leo Gardner, Birmingham, Mich., foundry instructor, poses a question as he and his colleagues gather new information on industrial practices to present to their students during next term.

SHELL MOLDERS:
Speed Shell Production with
DOW CORNING 8 EMULSION
(SILICONE PARTING AGENT)

You'll say it's "sheer magic" when you see the way Dow Corning 8 Emulsion helps increase production of dimensionally accurate sand-resin shells and shell cores.

The silicones in Dow Corning 8 are so remarkably heat resistant, they refuse to decompose at molding temperatures. With only a minimum of build-up, molds stay clean much longer . . . You spend more time **producing** good shells, less time cleaning patterns.

Let Dow Corning Silicones lend a hand in getting longer production runs from your patterns. Use Dow Corning 8 silicone emulsion for easy release, less build-up and lower costs.

8 reasons why . . .

LEADING SHELL MOLDERS PREFER DOW CORNING 8 EMULSION water-dilutable silicone parting agent . . .

• quick, easy release • easy to apply — faster wetting action • economical in extremely low concentrations • resists creaming or separation • minimum build-up — closer tolerance shells • stepped-up production — maximum number of shells between pattern cleanings • nonflammable • fast delivery from centrally located warehouses.

Generous Free Sample and new "how to do it" brochure on Shell Molding with Silicones are yours for the asking. Address Dept. 7920

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS DETROIT LOS ANGELES NEW YORK WASHINGTON, D. C

Circle No. 142, Page 7-8

for the asking

Continued from page 27

sand mixes with resin binders, and shows manufacturers and trade names of thermosetting synthetic resins. *Allis-Chalmers Mfg. Co.*

Circle No. 86, Page 7-8

Chemically-bonded brick bulletin, 4 pp, outlines foundry uses and properties. Available in firebrick and cupola sizes. *Illinois Clay Products Co.*

Circle No. 87, Page 7-8

Metal control and its effect on gray iron properties in ½ to 6 in. sections is detailed in 20-p booklet. *Herbert A. Reece & Assoc.*

Circle No. 88, Page 7-8

Conversion chart available for Rockwell and other hardness scales. Also contains tables for cylindrical corrections. *Torsion Balance Co.*

Circle No. 89, Page 7-8

High-vacuum equipment for laboratory and general applications is explained in 24-p catalog. One section deals with high-vacuum furnaces including induction and arc types for pilot plant and large-scale production. *Rochester Div., Consolidated Electro-dynamics Corp.*

Circle No. 90, Page 7-8

Ultrasonic cleaner for metallography is discussed in equipment catalog. Also covered are interference, inverted and metallurgical microscopes. *Buehler Ltd.*

Circle No. 91, Page 7-8

Iron foundry alloy bulletin covers ferrochromium, ferrocilicon, ferrovanadium and special alloys. Each is listed as to the alloy content with brief description of benefits. *Vanadium Corp. of America.*

Circle No. 92, Page 7-8

Instrumentation and control bulletin, 12 pp, includes units for pressure, flow, temperature, levels, gas analysis, receivers, and controllers. Chart provides quick reference for solution to process variable problems. *Hays Corp.*

Circle No. 93, Page 7-8

Ductile iron data sheet lists tables for effect of heat treatment and types of ductile iron. Physical properties for type 80-60-03 are also given. *Advance Foundry Co.*

Circle No. 94, Page 7-8

Heating element alloy, nickel-chromium-iron, for use in controlled atmosphere furnaces operating up to 1800 F is presented in 12-p bul-

letin. Includes temperature-resistance curve, tables giving resistance tolerances and physical properties, and basic factors to consider in designing strip, rod, and coiled-wire elements for furnaces. *Hoskins Mfg. Co.*
Circle No. 95, Page 7-8

Green sand facing material said to replace sea coal, pitch and cereal binders is completely volatile at elevated temperatures. Aids in eliminating blows, scabbing, buckling, rattailing, washing and cutting. *Delta Oil Products Co.*
Circle No. 96, Page 7-8

Melting furnace catalog, 30 pp, describes reverbatory melting furnaces. Includes data on metallurgical considerations, melting technique, furnace operation and fuel consumption. *International Foundry Supply Co.*
Circle No. 97, Page 7-8

Pneumatic core handling equipment, barrows, trucks, and racks, are subjects of 4-p catalog. Heavy coil springs, pneumatic tires on ball-bearing wheels give resiliency. *Chicago Mfg. & Distributing Co.*
Circle No. 98, Page 7-8

Nickel-tin bronze alloy catalog, 24 pp, includes engineering properties and applications. Also discusses availability, hardening and physical properties. Illustrated with charts, tables, and photos. *International Nickel Co.*
Circle No. 99, Page 7-8

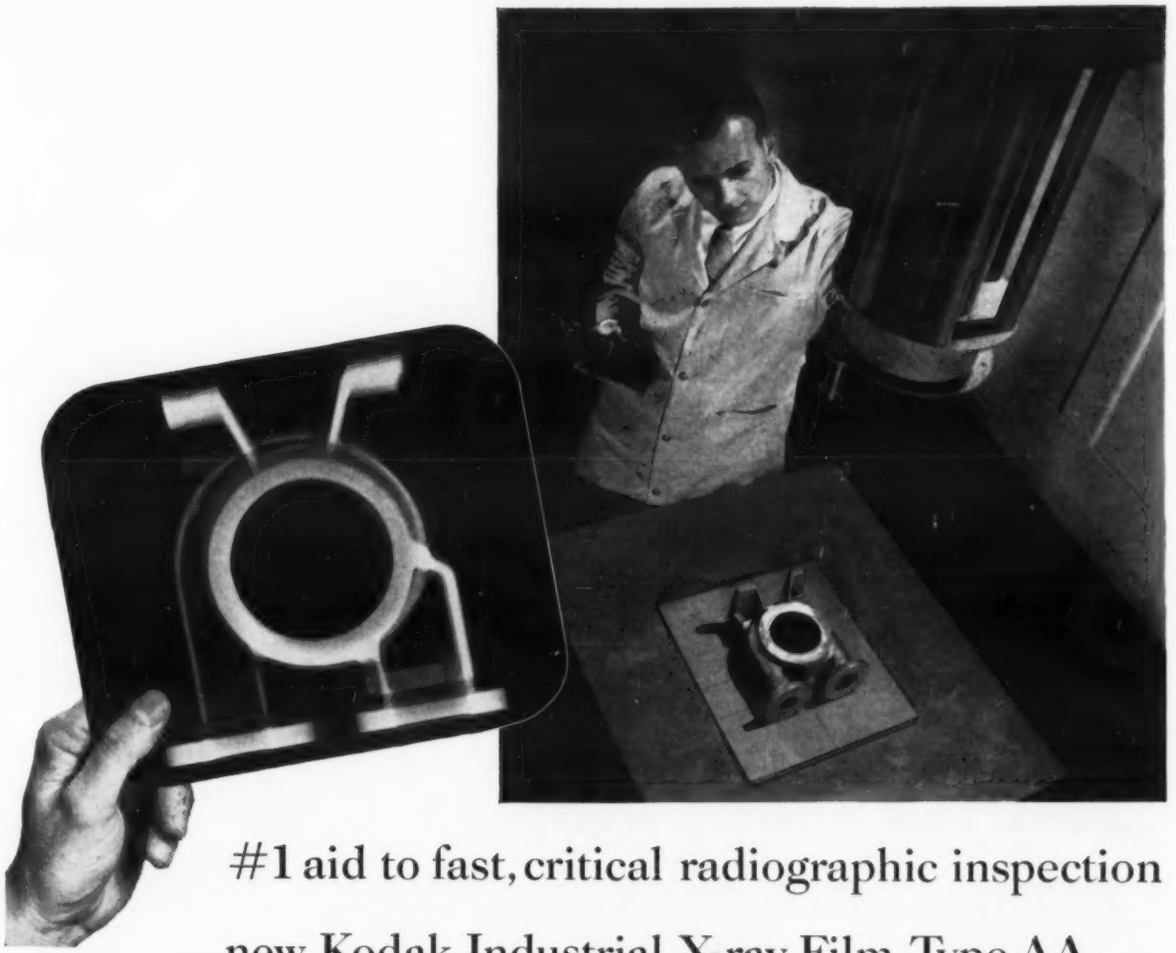
Metal surface treatment booklet, 84 pp, deals with rust prevention, mechanical and chemical cleaning, blackening, phosphating and other processes. Various treatments are diagrammed or illustrated. *E. F. Houghton & Co.*
Circle No. 100, Page 7-8

Foundry materials handling catalog, 56 pp, has electric vibrators, electromagnetic and mechanical vibrating screens, vibratory packers, hopper level switches, shakeout beams and grids, sieve shakers, batch weighing units, and dry feeder machines. *Syntron Co.*
Circle No. 101, Page 7-8

Designers kit shows how small die cast parts can eliminate or reduce tooling, manufacturing, machining, and assembly operations. Process allows production of multiple moving part units in a single operation. *Gries Reproducer Corp.*
Circle No. 102, Page 7-8

Industrial radiography bulletin 24 p provides information on x-ray films, chemicals and screens. Illustrated with characteristics and technique curves, speed and detail charts. *E. I. DuPont de Nemours & Co.*
Circle No. 103, Page 7-8

Bulk material equipment catalog, 12 pp, includes vertical tanks, horizontal



#1 aid to fast, critical radiographic inspection

...new Kodak Industrial X-ray Film, Type AA

TODAY'S radiographic inspection calls for increased sensitivity and greater speed. And these are the characteristics of Kodak's newest industrial x-ray film, Kodak Industrial X-ray Film, Type AA.

This film retains all the excellent qualities that made Kodak Type A the most widely used x-ray film in industry. Then, in addition, it provides greatly increased speed.

This permits exposure time to be cut as much as 50%. It allows adjustment of the radiographic factors to obtain greater contrast and easier readability.

Kodak X-ray Film, Type AA can multiply your minutes—can extend the usefulness of your present radiographic equipment.

Find out all the ways it can improve your production. Get in touch with your x-ray dealer or Kodak Technical Representative.

EASTMAN KODAK COMPANY
X-ray Division Rochester 4, N. Y.

Read what the new Kodak Industrial X-ray Film, Type AA, does for you:

- Reduces exposure time—speeds up routine examinations.
- Provides increased radiographic sensitivity through higher densities with established exposure and processing technics.
- Gives greater subject contrast, more detail and easier readability when established exposure times are used with reduced kilovoltage.
- Shortens processing cycle with existing exposure technics.
- Reduces the possibility of pressure desensitization under the usual shop conditions of use.

Kodak

Kodak Industrial X-ray Film, Type AA and Type M is now available in 100-sheet boxes wrapped without interleaving paper. Designated as AA-100; M-100.

Circle No. 143, Page 7-8

Each batch of sand is carefully checked in the Wedron laboratory during washing, drying and grading operations.

99.9% PURE SILICA
WEDRON
SILICA COMPANY
INDUSTRIAL SAND

Does Your Casting Operation Require Controlled Quality Sand?

The chances are good that you need far better casting sand now than you did 10 years ago, or even five. Methods have changed and so have sands. Sand nowadays must be graded very carefully by well equipped plants. Inspection and control is highly important in modern sand processing. This takes competence and technical knowledge. You just can't dig it up and ship it.

This is why it pays you to buy your foundry sand from Wedron. We regularly process, as standard, 17 grades for foundry use. Each is a uniform, white, and rounded grain sand, ideal for making high quality castings.

In addition, we offer 7 grades of ground silica flour, each also closely controlled to meet rigid specifications.

Our deposit is the finest raw material—white rounded grain sand from the famous Ottawa-Wedron district. These sands are thoroughly washed, screened, dried, inspected and bagged in our modern plant. They are then delivered to you as the finest foundry sand product available today.

Why not make your next order Wedron? You will be surprised at the increased quality you get for your sand dollars.

NEW SAND BOOKLET

This new booklet gives all the details on Wedron Sands for all kinds of industrial uses. Complete descriptive folder details the Wedron processing operations which produce the finest rounded grain silica sands. 24 separate standard grades are tabulated and chemical analysis of sand is given. Numerous illustrations of the Wedron plant and facilities are shown. Send for your copy today!

MINES AND MILLS IN THE OTTAWA-WEDRON DISTRICT
WEDRON
SILICA COMPANY
135 South LaSalle Street, Chicago 3, Illinois

WEDRON

Circle No. 144, Page 7-8

tanks, and pneumatic conveying equipment and systems. One page is devoted to dust control equipment. *Day Co.*

Circle No. 104, Page 7-8

free films

■ Motion pictures and other visual aids based on foundry processes and supplies are also yours *for the asking*. These films are suggested for formal or informal training groups. The owners of films listed in this column will send booking request forms to MODERN CASTINGS readers who circle the appropriate number on the Reader Service card (pages 7-8).

Men and Molds, 16 mm motion picture, sound, black and white, 35 min. running time. Depicts gray iron foundry operations. *Lynchburg Foundry Co.*

Circle No. 105, Page 7-8

Precision Investment Casting, 16 mm motion picture, sound, color, 12 min running time. Shows various steps involved in process. *Allis-Chalmers Mfg. Co.*

Circle No. 106, Page 7-8

Shell Molding, 16 mm motion picture, black and white, sound. Provides introduction for discussion of shell molding. Twenty-two mounted display photographs available with film. *Monsanto Chemical Co.*

Circle No. 107, Page 7-8

Chemistry of Aluminum, 16 mm motion picture, 16 min. running time. Explains mining and purification of bauxite, electrolysis of alumina, production of chemicals and reviews present-day uses. *Motion Picture Dept., Reynolds Metals Co.*

Circle No. 108, Page 7-8

How to Make a Motor Go, 35 mm sound slide films, colored, 20 min. running time. Deals with maintenance of electric motors *Allis-Chalmers Mfg. Co.*

Circle No. 109, Page 7-8

Shell Molding System, 16 mm motion picture, color and sound, 15 min. running time. Explains system in foundry following the entire system. *Link-Belt Co.*

Circle No. 110, Page 7-8

Automation as Applied to Core Making, 16 mm motion picture, silent, color, 15 min. running time. Portrays use of 5-station, automatic coremaking machine. *Cadillac Motor Car Div., General Motors Corp.*

Circle No. 111, Page 7-8

MORE FACTS on all products, literature, and services shown in the advertisements and listed in Products & Processes and in For the Asking can be obtained by using the handy Reader Service cards, pages 7-8.

Penn State Conference

Continued from page 51

educated to the beneficial properties of gray iron so they will expand their uses. Although top management is doing more about marketing than ever before, the practical operating foundrymen can influence the future of the industry with their daily, conscientious efforts to produce better quality at competitive prices.

Charles Walton, Gray Iron Founders' Society, Inc., followed with sound advice on "Producing What Your Customer Wants." Increased technical know-how is needed to produce quality castings competitively. Gating and risering, as well as most other foundry operations, are requiring technological skills which can only be met by having more highly-trained men.

W. W. Kerlin, Meehanite Metal Corp., demonstrated with the aid of slides, "Reduced Cost Through Good Cupola Control." A number of examples were cited showing how superficial supervision around a cupola can result in an accumulation of errors that can precipitate a crisis in quality and cost.

T. W. Curry, Lynchburg Foundry Co., told a capacity audience about "Recent Foundry Developments with Respect to Quality Control of Gray and Ductile Iron Castings." Included in the talk was a detailed description of the construction and operation of their basic-lined, water-cooled, hot-blast cupolas by Lynchburg Foundry.

■ Non-ferrous

Presiding — William A. Mader, Oberdorfer Foundries, Inc.

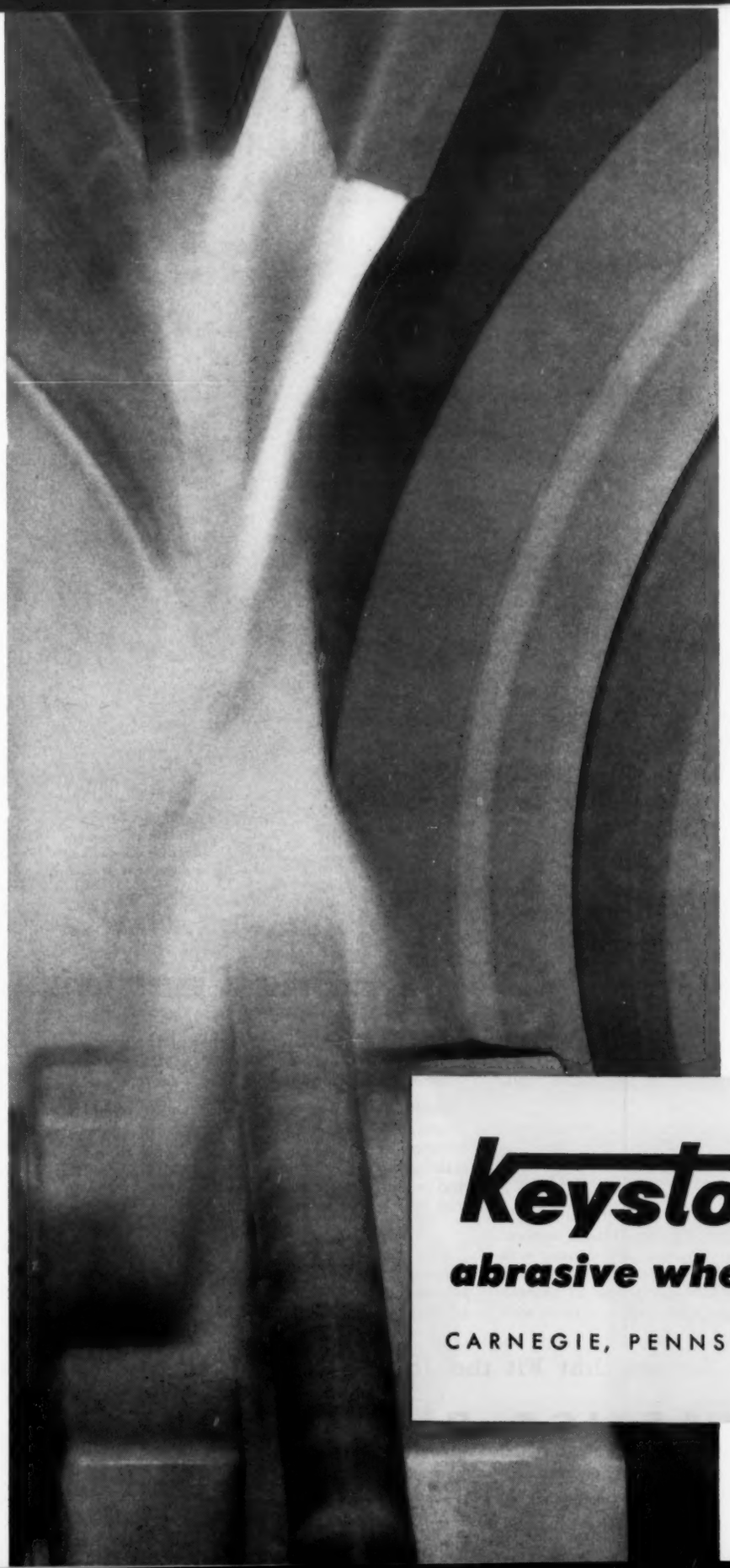
L. G. Day, Light Alloys Limited, Haley, Ontario, talked about "Canadian Light Alloy Foundry Practice and Technical Problems Encountered in Casting Magnesium-Thorium Alloys." An air-driven mechanical stirrer is used to mix rare earth pellets in magnesium and in fluxing operations. Practices geared to the requirements of the Canadian aircraft industry included melting equipment, shell and CO_2 coremaking, flushing with dry N_2, and use of exothermic mold materials.

Walter E. Sicha, Aluminum Co. of America, discussed "Aluminum Foundry Practice." Subjects covered included core binders, insulating coatings on chills, directional solidification, hot-cracking cures, and elimination of oxide inclusions.

R. A. Colton, Federated Metals Div., American Smelting and Refining

Continued on page 60

Circle No. 145, Page 7-8



Keystone

centerless grinding... in Action

at ALLEGHENY LUDLUM DUNKIRK, N. Y.

A-L demands top performance from their grinding wheels—the kind of performance that keeps production high and costs down. Keystone wheels are giving A-L this type of performance day after day in finishing and snagging operations. Keystone can supply your every grinding need, too. Our reputation is built upon quality and service.

Interested in Centerless Grinding facts? Send for our FREE booklet, today!

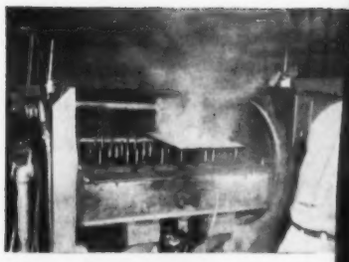
Grinding operation stopped for purposes of illustration.

Keystone

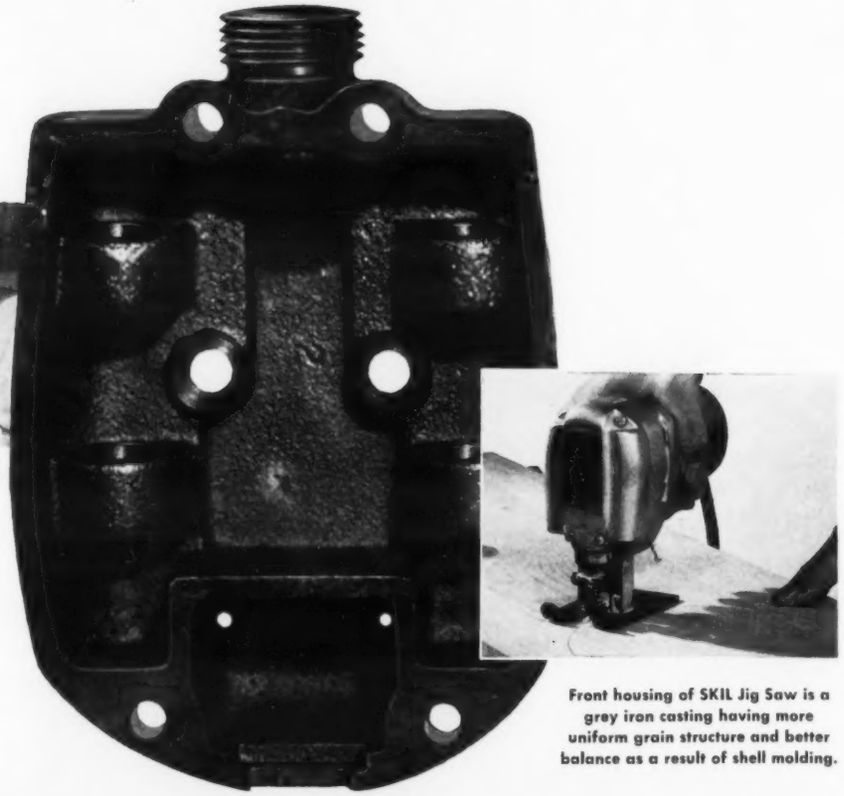
abrasive wheel co.

CARNEGIE, PENNSYLVANIA

finer castings from shell molds



Shell molds for front housing casting of SKIL Model 511 Jig Saw in production at Woodruff & Edwards, Inc., Elgin, Ill.



Front housing of SKIL Jig Saw is a grey iron casting having more uniform grain structure and better balance as a result of shell molding.

...foundry and customer benefit from **DUREZ RESINS**

IT'S A LOT EASIER to obtain the closer dimensional accuracy and minimized machining and polishing you expect with shell molding, when the molds really meet your specs.

Experience with Durez phenolic resins bears this out, according to Mr. Wayne Wright, Shell Division Manager at Woodruff & Edwards, Inc., a jobbing foundry at Elgin, Ill.

With seven shell machines in operation, Mr. Wright is getting molds of more uniform grain structure and density with Durez. Uniformity is obtained over a wider range of pattern temperatures and in sections with deep draws. On high projection patterns there is no peel-back or fall off. Molds build up faster during investment, so the production cycle is shorter, too.

Shells and cores bonded with Durez resins have superior hot and cold strength, permitting the most economical sand-to-resin ratios. Whether your mold-making operations are based on dumping or blowing, find out now how these resins can improve them. A trial shipment is all you need for a starter.

• • •

Shell mold production with resin coated sand is authoritatively discussed in our 16-page booklet covering simplified procedure, coating methods, solvents, test methods, etc. Ask us for the "Durez Guide to Resin Coated Sand".

DUREZ®

Phenolic Resins that Fit the Job

DUREZ PLASTICS DIVISION

HOOKER ELECTROCHEMICAL COMPANY

1908 WALCK ROAD, NORTH TONAWANDA, N. Y.

HOOKER CHEMICALS PLASTICS

Circle No. 146, Page 7-8

Penn State Conference

Continued from page 59

Co., described "Modern Gating and Risering of Non-ferrous Alloys." The difference between aluminum and copper-base alloys was made apparent by contrasting handling during pouring, and gating and risering techniques.

E. A. Lange, Naval Research Laboratory, explained the advantages of "Vacuum Degassing of Non-ferrous Metals." Continuing work in this field has led to improved degassing efficiency by agitating the melt in the vacuum chamber by bubbling N_2 gas through it.

Alan B. DeRoss, Kaiser Aluminum & Chemical Sales, Inc., talked about the new "High Purity 355 and 356 Alloys." By holding the iron content in these alloys to a maximum of 0.15 per cent and using higher aging temperatures, both strength and ductility of these alloys exhibit marked improvements.

■ Malleable Iron

Presiding—C. O. Williamson, Grinnell Corp., and T. M. Blank, Pennsylvania Malleable Iron Corp.

Joseph Dvorak, Eberhard Div., Eastern Malleable Co., described "General Melting Practice in Malleable Iron." Producing malleable by duplexing and by direct melting was covered in his talk. Also included were descriptions of auxiliary equipment for hot blast, humidity control, combustion control, water-cooling cupola, and dust collection.

Lyle R. Jenkins, Wagner Malleable Iron Co., told how to produce uniform properties in malleable through "General Annealing and Pearlitic Practice." The talk covered molten metal requirements, heat treating cycles, and equipment. The process and equipment described was designed and operated to give the customer fast service at the lowest cost, keeping high, uniform quality as the foremost consideration.

Henry Felten, Peoria Malleable Casting Co., told how to set up a "Scrap Reduction Program." Effective scrap control requires the foundry to 1) collect pertinent data, 2) pin point problems, 3) investigate causes, and 4) take corrective action. A scrap reduction program is a tool which will produce results commensurate with its intelligent use.

R. L. Gilmore, Superior Steel and Malleable Castings Co., explained the advantages of designing castings by "Stress Analysis Use." Careful study of casting design by applying stress

coat and strain gages to static stress loading and dynamic field tests leads to the optimum product. A color movie was shown to give visual demonstration of how this approach is applied from the first contact with the customer to delivery of finished casting.

T. E. Eagan, Cooper-Bessemer Corp., told foundrymen about "Nodular Iron as an Engineering Material." Nodular iron is competing with pearlitic malleable and has the advantage of no limitation on the size of castings that can be cast. A comparison was made between A.S.T.M. specification for nodular and pearlitic malleable.

■ Sand School

Presiding—W. P. Winter, Pennsylvania State University.

O. Jay Myers, Reichhold Chemicals Inc., and **Clyde A. Sanders,** American Colloid Co., shared the responsibility of teaching the "Principles of Molding and Core Sand Technology." This 4-hour session followed as its guideline the AFS Sand Technology Short Course. Myers handled core sand discussion while Sanders covered molding sand. Questions from the audience led to elaboration of details on certain phases.

The sand school was completed by **Victor M. Rowell,** Harry W. Dietert Co., with a session on Saturday morning devoted to "Foundry Sand Testing and Control."

■ Mechanization

A special session on mechanization was chairmaned by E. C. Troy, National Engineering Co., and addressed by **J. E. Micksch,** JEM Laboratories, Inc., on the subject of "Automation of the Sand System." Automation is the next step after mechanization but like any other new development is fraught with as many eccentricities as the man it is intended to replace. Automatic moisture controls for sand systems must be compensated for changes in temperature, residual moisture, and stratification, in order to attain the ±0.1 per cent moisture control that is possible.

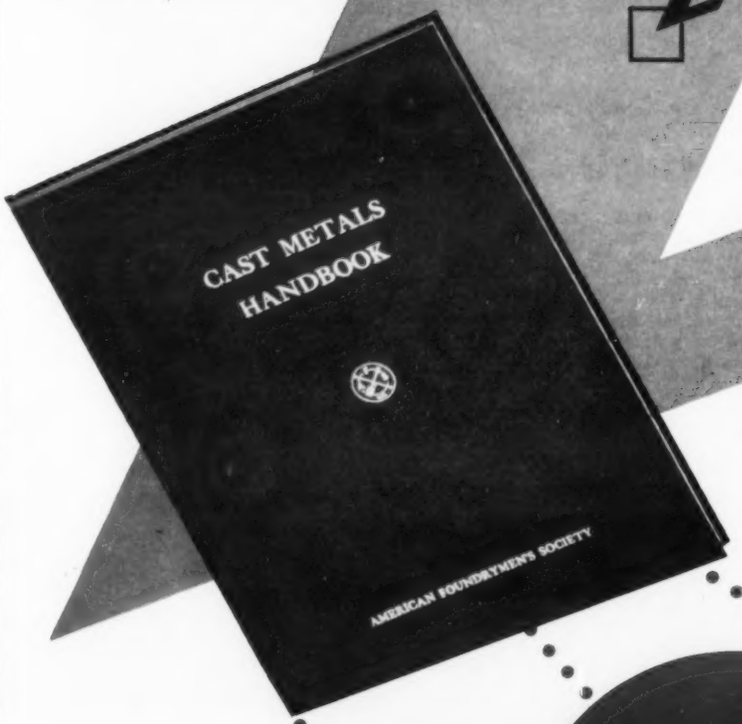
The conference was sponsored by the American Foundrymen's Society, Foundry Educational Foundation, Foundry Equipment Manufacturers' Association, the following AFS Chapters: Central New York, Chesapeake, Eastern New York, Metropolitan, Northwestern Pennsylvania, Ontario, Philadelphia, Pittsburgh, Rochester, Western New York; and the Conestoga, Lehigh Valley, and Reading Foundrymen's Associations.

Circle No. 166, Page 7-8

CAST METALS Handbook

AUTHORITATIVE REFERENCE FOR DESIGN-ENGINEERS

BASIC CREATIVE KNOW-HOW IN METAL



Industrial development, change and new product opportunities have created a demand for an essential engineering reference volume. The new Fourth Edition of the CAST METALS HANDBOOK brings existing information on cast metals up to-the-minute.

Constant research in industry results in constantly increasing new developments in materials and science. It's when the developments reach the Design-Engineer for conversion into components and end products that the CAST METALS HANDBOOK becomes an indispensable source of information.

Every chapter of the revised edition is reworked and augmented, with such completely new sections as: Casting Design, Cross Index of Equivalent Ferrous and Nonferrous Casting Alloy Specifications, Heat Treatment of Gray Iron, Pearlitic Malleable Iron, Nodular Cast Iron, Titanium-Base Alloys and Zinc-Base Alloys.

The NEW Cast Metals Handbook

CONTAINS:

1 Reliable working data for utilizing the properties of cast metals to the greatest engineering advantages.

2 Unbiased and substantiated information on new, reliable developments in cast materials.

3 Practical, up-to-date facts on HOW to get the most out of castings designs.

THE CAST METALS HANDBOOK is compiled specifically to enable the user of cast metals to select the material best suited for his purpose . . . to give him needed information that will facilitate cooperation with foundries, to obtain castings which will best meet every aspect of his engineering requirements.

$10.00 List Price

Available to AFS Members at $7.00

Evidence

of the value of the Cast Metals Handbook is indicated in the sale of 10,000 copies of the previous edition . . . and this Fourth Edition is completely modernized and enlarged. EVERY MODERN-THINKING PRODUCT-DESIGNER NEEDS THIS HANDBOOK!

AMERICAN FOUNDRYMEN'S SOCIETY
Golf & Wolf Roads, Des Plaines, Illinois

Please forward . . . . . copies of the 1957 Edition of the AFS CAST METALS HANDBOOK. ☐ I am an AFS Member. ☐ I am not an AFS Member. I enclose $ . . . . . In ☐ Money Order ☐ Check ☐ Send Invoice

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

local foundry news

Aggressive Mexico Chapter Program Turns Problems into Opportunities

Chapter concentrates efforts on local, regional activities

Problems of distance, securing speakers, and conducting publicity and educational programs have been made into opportunities by the Mexico Chapter.

Located far from the National Office and other chapters, the Mexico Chapter has drafted its own list of speakers, is conducting an educational program and cooperating with other technical societies and institutions to study foundry and related problems.

In February, Esteban Fuchs, Funidora Panamericana, S.A., was elected Chapter Chairman, succeeding Delbert Luper, Iturbey Zalce. Vincente Nacher Todo, La Consolidada, S.A., was elected Chapter Vice-Chairman.

A summary of the chapter's activities:

February—In addition to the election of chapter officers, a list of 11 subjects and 25 potential speakers was prepared with Mr. Todo elected as program chairman. Fernando Gonzalez Vargas, Teziutlan Copper Co., spoke on *"Production of Special Steels in Mexico,"* covering production data on steels and giving an estimate of future requirements and contemplated new installations during the next 10 years.

March—Joseph Kirshon, Mueller Brass de Mexico, spoke on the CO_2 process. Chapter officers attended the Industrial Association of Producers of Iron & Steel congress. Technical, economic, and legal problems within the steel industry were discussed.

May—Ricard Menendez, International Nickel Co., spoke on *"Nodular Iron, Its Production and Application."*

Meetings for the balance of 1957 include a round-table discussion on patternmaking and sessions on malleable iron production, steel castings, gray iron castings, what industry in Mexico requires from the foundry industry, aluminum castings, and a meeting outside of Mexico City.

The chapter has established a foundry terminology committee and is cooperating with other technical societies in preparing a metallurgical dictionary.

Much of the chapter's activity is devoted to a basic training program for foundry workers.

Air pollution legislation affecting foundries was discussed at the May meeting of the **Philadelphia Chapter**. John M. Kane, American Air Filter Corp., Louisville, Ky., was the featured speaker. Attending as guests of the chapter were Walter Wagner, air pollution committee of the Philadelphia Chamber of Commerce, and Raymond Smith, Philadelphia Department of Health Air Pollution Control. Mr. Kane asserted that the problem of reducing air pollution is less difficult than the problem of establishing regulations that will reduce industrial air pollution as far as possible and still stay within the performance range of present equipment at reasonable cost and maintenance. Control is attainable, he emphasized, if the problem is approached intelligently by local governing bodies and the industry. Left to right are W. A. Morley, Link-Belt Co., Philadelphia, technical chairman; speaker Kane; and guests Smith and Wagner. About 60 foundrymen attended.

Western New York Chapter's annual Spring dance was held during April. Left to right are A. J. Heysel, chapter secretary; Robert Lumley, entertainment chairman; E. J. Burke, vice-chairman; M. D. Emery, chapter chairman; and Leonard Greenfield, director. Ladies from left to right are Mrs. Lumley, Mrs. Burke, Mrs. Emery, and Mrs. Greenfield.

MILWAUKEE CHAPLET PHOTO

Wisconsin Chapter members honored old-timers and apprentices at the May meeting. Shown in photo, left to right, are Wisconsin winners in the National AFS Apprentice Contest. They are: Elden C. Willing, Waukesha Foundry, Waukesha, Wis., 3d place, steel molding; Ralph W. Tolle, Waupaca Foundry, Inc., Waupaca, Wis., 3d place, iron molding; Arnold L. See, Waukesha Foundry, Waukesha, Wis., 1st place, steel molding; and Raymond J. Hollfelder, Zenith Foundry Co., Milwaukee, 1st place, iron molding.

Development of standard specifications for cast copper alloys were discussed by V.P. Weaver, American Brass Co., at the April meeting of **Lehigh Valley Foundrymen's Association** held at Lafayette College, Easton, Pa. A movie concerning underground mining was also shown. Dr. Ralph C. Hutchinson, president of Lafayette College, welcomed the group at a dinner. "Fish Hatchery Management," a motion picture, was shown by C. R. Glover and Allen Butz of the Pennsylvania Conservation Department. Seated left to right are Allen Butz, C. R. Glover, Chairman Robert Latham, and Dr. Hutchinson. In the back, Mr. Wilson, Speaker Weaver, Technical Chairman Dawe, Vice-Chairman Albert Mathieu.

MILWAUKEE CHAPLET PHOTO

Education was the theme of the May meeting of the **Pittsburgh Chapter.** Earl M. Strick, Erie Malleable Iron Co., Erie, Pa., spoke on *"Foundry Education on the Secondary School Level."* Representatives of the Pittsburgh and Allegheny County Boards of Education were special guests.

Certificate of Appreciation

This is to certify that

Duale Fakale

addressed a scheduled meeting of the membership of

THE WISCONSIN CHAPTER

of the

American Foundrymen's Society

and this certificate is awarded to him in recognition of his contribution to the advancement of foundry processes and techniques.

Speakers addressing the **Wisconsin Chapter** are presented with a certificate of appreciation as a permanent record of thanks to their speakers.

Conducting industrial relations on a large scale was explained at the May meeting of the **Saginaw Valley Chapter** by Norman J. Ellis, director of industrial relations, Chevrolet Motor Co. Div., GMC. Mr. Ellis, shown on right with program technical director W. C. Schartow, is responsible for 75,000 workers in 30 Chevrolet plants. King-size chapter plaque was made by the Dowmetal Foundry of Dow Chemical Co. Between regular meetings it is displayed by the General Motors Technical Foundry Club.

Continued on page 64

YESTERDAY'S OPTIMUM ---FERRO KOTE IS TODAY'S PRACTICE

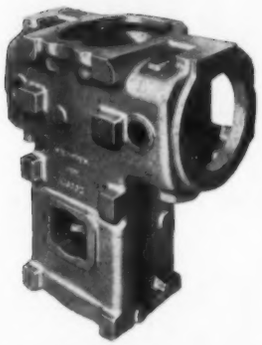
More and more foundrymen prefer Ferro Kote core and mold coatings every year.
Less Cleaning Costs
✓ No sand fusion
✓ Smoother surfaces
✓ Easier mixing
✓ Excellent suspension
SOLD WITH SERVICE
Ask Your Thiem Man!
Thiem

PRODUCTS INCORPORATED
Milwaukee 19, Wisconsin

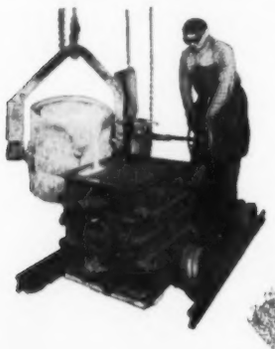
THIEM DISTRIBUTORS

Brumley-Donaldson Company, Los Angeles & Oakland, Calif.
Manufacturers Equipment & Supply Co. Chattanooga, Tenn. & Birmingham, Ala.
LeGrand Industrial Supply Co. Portland, Oregon
Combined Supply & Equip. Co., Inc. Buffalo, New York
Walter A. Zels, Webster Groves, Missouri
Pearson & Smith, Spokane, Washington
Don Barnes Foundry Supplies & Equip. Hamilton, Ontario, Canada
Western Foundry Sand Co. Seattle, Washington
Kramer Industrial Supply, Inc. Denver, Colorado
Horace G. Stults, York, Penna.
Springfield Facing, Inc. Harrison, New Jersey
C. Eugene Silver, Houston, Texas

Circle No. 149, Page 7-8



More and Better Castings at Lower Cost call for...



Hotter, Cleaner, More Fluid Iron. You'll get it with...

NEVILLE FOUNDRY COKE

FROM actual production experience, you know that you can usually pour more *top-quality* castings per ladle when you begin with hotter, cleaner, more fluid iron.

That's why it pays to specify *Neville* Foundry Coke. It consistently provides maximum melting temperature at the nose of the tuyere because it's a dense, strong, uniform coke—with more fixed carbon and less ash and sulphur. *Neville* Foundry Coke is scientifically processed from clean, washed coals containing a high percentage of Pocahontas.

If you're interested in upgrading the quality and increasing the efficiency of your gray iron castings production, specify *Neville* on your next foundry coke order. ● *Our technical service department will be glad to work right along with your production people.*

Neville Pig Iron and Neville Coke for the Foundry Trade

WSW 6466

COAL CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

Circle No. 150, Page 7-8

Continued from page 63

Industrial Safety Talk Heard by Metropolitan Brass Group

Industrial safety was discussed at the May meeting of the Metropolitan Brass Founders Association held at Richmond Hill, N. Y. Joseph Marchetti, New York State Department of Labor, Division of Industrial Safety Service, used charts and figures to illustrate the annual loss in dollars and man-hours due to injuries. He stated that burns, scalds, fractures, cuts, strains and sprains accounted for four-fifths of industrial injuries.

Dr. Douglas Williams, associate professor, metallurgical department, Ohio State University, discussed ions and their relation to binders at the May meeting of the **Central Ohio Chapter.** He said that the hydrogen ion bond requires the highest amount of temper water to develop dry strength of a molding sand mix. The calcium ion bond present in southern bentonite requires less temper water, percentage-wise. The sodium ion bond present in western bentonite gives high dry strength with the least amount of temper water. These comparisons among the different bonds are the result of tests using the same grade of sand.

MILWAUKEE CHAPLET PHOTO

Officers were installed at the May meeting of the Northwestern Pennsylvania Chapter. Officers left to right are: president, W. R. Ferguson, Pickands Mather & Co.; secretary, E. J. Bonesteel, General Electric Co.; and vice-president, W. S. Hodge, Hodge Foundry Co.

Pollution Control Sales Grow

■ Sales of dust collection equipment, now estimated, by one source, at 300 million dollars, are expected to increase with the nation's general industrial expansion and additional legislation. Joy Mfg. Co., Pittsburgh, Pa., estimates that air pollution causes damage of more than 2 million dollars annually in addition to its effect on health.

afs chapter meetings

AUGUST

Canton District . . Aug. 3 . . Brookside Country Club, Barberton, Ohio . . *Annual Picnic and Golf Party.*

Chicago . . Aug. 10 . . Nordic Hills Country Club, Itasca, Ill. . . *Annual Stag and Golf Outing.*

Texas . . Aug. 23 . . Fredonia Hotel, Nacogdoches, Texas . . *Officers' and Directors' Meeting.*

SEPTEMBER

Central New York . . Sept 13 . . Trinkaus Manor, Oriskany, N.Y. . . M. Bock II, Exomet, Inc., *"Exothermic Compounds–Insulated Risers."*

Central Ohio . . Sept. 9 . . Seneca Hotel, Columbus, Ohio . . T. E. Barlow, Eastern Clay Products Dept., International Minerals & Chemicals Corp., *"Green Sand Molding."*

New England . . Sept. 9 . . Whitin Machine Works, Whitinsville, Mass., *Plant Visitation.*

Chesapeake . . Sept. 27 . . Engineers' Club, Baltimore, Md. . . W. B. Bishop, Archer - Daniels - Midland Co., *"Which Core Process."*

Texas . . San Antonio Section . . Sept. 23 . . Alamo Iron Works, San Antonio, Texas.

Use of Wetting Agents Speeds Cupola Lining

■ A faster and more effective bond, less drop or rebound and a denser, longer-lasting lining in cupola repair are said to result from the addition of a wetting agent.

The use of monolithic linings applied by the air placement method is receiving increased use. In this method, the clay in the mix must be wet in the short distance between the nozzle and the wall to allow the bond to develop. Insufficient water or clay results in rebound. If too much water is used to reduce rebound, the lining has a tendency to slump.

Wetting agents with their ability to reduce surface tension, allow the clay to be wet faster. Aquadyne Corp. states that the use of a wetting agent will reduce rebound by at least 50 per cent.

committees in action

■ Results from the tests of five types of sea coal were announced at a meeting of the Effects of Carbonaceous Materials Committee, Sand Division, at a meeting held at Michigan State College, East Lansing, Mich., March 29-30.

Types of coals sampled by the committee were: plus 30 mesh; minus 30, plus 100; minus 100 mesh; low free swelling index; and high free swelling index.

The control sand was composed of 95 per cent Wedron silica sand and 5 per cent western bentonite; the sea coal sand was 90 per cent Wedron silica sand and 5 per cent each of western bentonite and sea coal.

One 6-in. high x 2½-in. diameter cylinder was cast in each sand. In all but one case, the peel was approximately 100 per cent. Radiographic examination of the cylinders showed a shrink cavity at the top of each cylinder but no internal shrinkage was detected.

■ Five chapters of the FOUNDRY NOISE CONTROL MANUAL were approved at the May meeting of the Safety, Hygiene and Air Pollution Control Steering Committee. One chapter of the RADIATION PROTECTION MANUAL was also given approval.

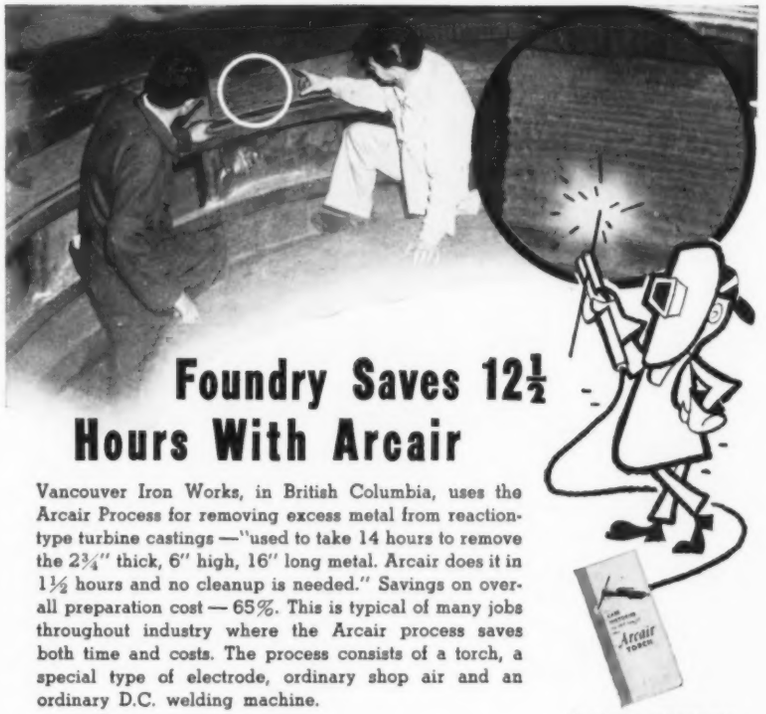
Committee action was initiated within the division on the problem of industrial odors.

To keep the committee informed on the latest developments in air pollution studies, a member of the U.S. Public Health Service from the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, has been invited to serve on the division steering committee.

■ Scheduling of future publications was discussed at the June meeting of the Publications Committee.

Among the manuals and technical books to be printed at future dates are: MOLDING METHODS AND MATERIALS, PATTERNMAKERS MANUAL, WELDING MANUAL, RADIATION HAZARDS, FOUNDRY CORE PRACTICES, FOUNDRY SAND HANDBOOK, STATISTICAL QUALITY CONTROL FOR FOUNDRIES, TIME AND MOTION STUDY, AND INDEX TO TRANSACTIONS–1950-1960.

Sale of all publications during the period 1955-1956 were 32.6% greater than during 1954-1955.



Foundry Saves 12½ Hours With Arcair

Vancouver Iron Works, in British Columbia, uses the Arcair Process for removing excess metal from reaction-type turbine castings —"used to take 14 hours to remove the 2¾" thick, 6" high, 16" long metal. Arcair does it in 1½ hours and no cleanup is needed." Savings on overall preparation cost — 65%. This is typical of many jobs throughout industry where the Arcair process saves both time and costs. The process consists of a torch, a special type of electrode, ordinary shop air and an ordinary D.C. welding machine.

Arcair COMPANY
P. O. BOX 431, LANCASTER, OHIO
P. O. BOX 4227, BREMERTON, WASH.

To help you cut costs over chipping and grinding, ask your Arcair dealer for an on-the-job demonstration, or write today for the case history booklet.

Circle No. 151, Page 7-8

Neff & Fry Silo used for calcined coke

Many of our silos are currently being erected for handling and storing calcined coke. Scores of them have been in use for the same purpose over the years. The photograph shows one such installation in Pennsylvania. It is 24 ft. dia. x 60 ft. high.

There are a number of special problems in designing systems for handling calcined coke and other materials of similar consistency. Our knowledge of the subject can be of great practical value. We'll be glad to communicate or confer with you.

Our silos are constructed of Super-Concrete Staves with diagonal ends which permit steel hoops to impinge directly upon the horizontal joints. As many intervening hoops are installed as needed to met the lateral thrust of the contents. This is clearly explained in our folder, "Bins With the Strength of Pillars." A copy is yours for the asking.

Not exported except to Canada and Mexico.

THE NEFF & FRY CO.
212 ELM ST., CAMDEN, OHIO

SUPER-CONCRETE STAVE STORAGE BINS

Circle No. 152, Page 7-8

SAND AND FLOUR

- Domestic and Australian zircon foundry sands
- Zircon foundry flours in 200 and 400 mesh particle sizes

Orefraction Inc.

7432 THOMAS ST., PITTSBURGH 8, PA.

DISTRIBUTED BY

BARKER FOUNDRY SUPPLY CO., Los Angeles; San Francisco
HOFFMAN FOUNDRY SUPPLY CO., Cleveland
FREDERIC B. STEVENS, INC., Detroit; Buffalo
PENNSYLVANIA FOUNDRY SUPPLY & SAND CO., Philadelphia; New York; New England
M. A. BELL CO., St. Louis; Tulsa; Houston; Denver
FIRE BRICK ENGINEERS CO., Milwaukee
LAGRAND INDUSTRIAL SUPPLY CO., Portland, Ore.
FOREMOST FOUNDRY SUPPLY COMPANY, Chicago
G. E. SMITH, INC., Pittsburgh, Pa.
EXPORT DEPARTMENT: 1010 Schaff Bldg., Philadelphia, Pa.
CANADIAN FOUNDRY SUPPLIES & EQUIP. CO., INC., Montreal; E. Maritimes
CANADIAN HANSON & VAN WINKLE CO., LTD., F. B. Stevens Division, Windsor; Toronto

Circle No. 153, Page 7-8

the SHAPe of things

safety, hygiene, air pollution

by HERBERT J. WEBER

IT'S HOT AS HELL!

Radiant Heat is not a lot of hot air

If your foundry is unbearably hot, read this before buying corrective equipment. The shop may be hot, not because of high air temperature but because of *radiant heat*. The difference in the two forms of heat is frequently overlooked, thus leading to misdirected efforts because measures which will control high air temperatures will not control radiant heat.

Nature of Radiant Heat

Notice how you will walk on the shady side of the street on a hot sunny day, thus avoiding radiation from the sun. You are more comfortable in the shade although (believe it or not) the *air temperature in the shade is scarcely lower than that in the sun!*

In foundries, hot metal, furnaces, ovens, etc., may be likened to miniature suns giving off radiant heat (infrared energy). Thus, to give your men some relief, get them in the shade. Set up industrial "shadows", because blowing air around the room, introducing outdoor air, or exhausting hot air will not reduce the radiant heat load at all.

This is because radiant heat is a form of radiation which has no effect until it falls on an object which will absorb it. It travels through air without heating it and is not affected by air motion. Fans cannot deflect it nor keep it from falling on a person.

Radiant heat striking an object is absorbed or reflected, depending entirely on the *surface* of the object. Polished metals such as aluminum are good reflectors. Most common objects such as wood, brick, asbestos board, etc., are good absorbers, which means they will absorb rather than reflect most of the radiant heat striking them.

The human skin and ordinary types of clothing are also good absorbers. Color of the clothing (counter to what is commonly believed) makes little difference. An object absorbing radiant energy becomes heated. If the object be a man, he gets hot! But good

absorbers are also good radiators. If surrounding objects are at a lower temperature than the man is, he will re-radiate heat to them and become cooler. If the surroundings are at a higher temperature than his skin, he accumulates heat. This fact furnishes a clue to control of radiant heat. Block it off. Set up a shadow by interposing a reflective barrier between the man and the heat source.

Control of Radiant Heat

Since in many foundry operations, 80% of the heat load is due to radiant heat and only 20% to convected heat (hot air), isn't it logical to control radiant heat first? It is also much cheaper to control than convected heat.

Aluminum shields positioned to reflect radiant heat away from the workers are most satisfactory. They should not be imbedded between other materials nor should they be painted. If covered with oil, grease, or soot, they lose their reflective property although ordinary dry dust does not affect this property. If mounted on a wall of a furnace or oven, they should be held out a few inches by brackets.

Structural steel members coated with aluminum paint will radiate less heat than unpainted steel.

Where visibility through the heat shield is necessary, aluminum screens may be used but with less effect than with sheet aluminum.

Results obtained with simple shields are often dramatic. In one instance the temperature in an area adajcent to the outside brick wall of a furnace dropped from 161 F to 99 F after shielding. Men could not work near that furnace before, even with the roof ventilators running full speed.

So before exhausting a lot of hot air from your foundry to take care of the convection component, better try controlling the radiation component—and it's cheaper!

MORE FACTS on all products, literature, and services shown in the advertisements and listed in Products & Processes and in For the Asking can be obtained by using the handy Reader Service cards, pages 7-8.

The number of full-time foundry teachers in FEF accredited engineering colleges has increased 400% in the last nine years.

The accompanying chart proves that foundrymen's interest in this subject is moving mountains . . . in the direction of a better industry.

It's up to you, literally, to keep up the momentum.

INSTRUCTION STAFFS—FOUNDRY PROFESSORS

19 1947

70 1956

Write for booklet "Let's Look Ahead".

You'll be glad you did.

Foundry Educational Foundation

1138 TERMINAL TOWER BUILDING • CLEVELAND 13, OHIO

Space contributed by **Modern Castings** as another service to the metal castings industry.

Circle No. 134, Page 7-8

Is Your Portable Electric Equipment Well Grounded?

■ Prevent electric burns and shocks by installing a separate ground wire from portable electric equipment to a low-resistance ground connection. This is the recommendation of the National Safety Council which also points out that indirect injuries are caused by ungrounded equipment.

The council suggests four considerations in grounding portable electric equipment:

■ When wiring is enclosed with metal conduit or protected by armored cable, all couplings and fittings used to make connections between the conduit or cable and the electrical equipment should provide metal-to-metal contact.

■ If the wiring is nonmetallic sheathed cable or knob and tube work—such as used in construction work—a third wire must be connected to the grounding terminal on the receptacle.

■ Ground wires should be checked to see size is correct for the capacity of the nearest fuse or other automatic cutout.

■ No fuses, automatic cutouts or hand-operated switches should be inserted in a grounding line.

A Complete Line of Plastic Refractories

Featuring:

Narcoline . . . highly slag-resistant graphite base

Narco 505 . . . for high heat duty

Narco Super 505 . . . for super duty

Narco Spar . . . for air-setting, super duty

Narcal 70B . . . for high alumina heat duty

Narchrome Plastic Refractory

. . . highly slag and abrasion-resistant.

Write for Bulletins 106 Rev., 111, and 115.

NORTH AMERICAN REFRACTORIES COMPANY
National City-East 6th Building • Cleveland 14, Ohio
DISTRICT SALES OFFICES
New York, N. Y. • Philadelphia, Pa.
Boston, Mass. • Buffalo, N. Y. • Pittsburgh, Pa.
Detroit, Mich. • Chicago, Ill. • Cincinnati, Ohio
NORTH AMERICAN REFRACTORIES, LTD., 191 Victoria Ave., South Hamilton, Ontario

questions and answers

Misery loves company so why not share your castings problems with us? MODERN CASTINGS invites you to "stump the experts" with tales of gremlins that are haunting your scrap piles. If any of you readers have better answers to the questions below, write the editor.

coated sand

Q. What are the advantages of resin coated sands for shell cores and molds?

A. By coating sands before use in shell molding or blowing equipment a number of advantages accrue. About 50 per cent less resin is used and yet each grain of sand is uniformly coated with a thin film of plastic. This tightly adhering film has no tendency to segregate—a serious problem when a dry resin-sand mix is blown into a core box or dumped onto a pattern plate. The completeness of the coating guarantees bonding at all surfaces where adjacent sand grains come into contact with each other. As a consequence shell cores and molds made with coated sands exhibit greater strength. Coating eliminates most of the dust hazard accompanying the use of the dry mix. With only half the plastic resin content in the core you have reduced by half the quantity of gas generated by molten metal contact. Also, resin costs are sliced in two. Sand may be coated cold, warm, or hot using the resin in form of powder, lump, or dissolved in a solvent.

wet water

Q. What benefits are derived from adding wetting agents to water used in molding sand?

A. By adding a wetting agent such as sodium lauryl sulphate to water its surface tension is reduced. Reduction in surface tension allows wet water to distribute itself through sand faster and more uniformly; less water is needed in molding sand mix; clay is wet faster so bond develops sooner with less mulling required; sand flowability improves; with less moisture present, mold drying is speeded.

smoke catcher

Q. Can any equipment be recommended that will collect stack discharge from a hot-blast cupola recuperator?

A. The stack emission from a cupola is approximately 97 per cent solids and balance volatile. Typical tests show that cold-blast cupola emission is about 15.4 pounds per ton of process weight and 5.5 for the hot blast. Certain hot-blast tests showed that approximately 23.6 per cent of emission is in the 0-5 micron particle size range 57.9 per cent is over 44 microns in size, and the balance lies between. The recuperator acts as a primary dust collector removing close to 65 per cent of the emissions. Wet collectors are not efficient in removing the 0-5 micron particles. Further handicaps arise in this type if the water is recirculated because oxides of sulphur are converted to sulphurous and sulphuric acid. Also oxides of carbon form carbonic acid and P_2O_5 in the effluent will generate phosphoric acid. Best results have been obtained using a tubular fabric-filter-type collector which gives an efficiency of 99 per cent with no visible discharge on either hot-or cold-blast cupolas.

You rang, Sir?

obituaries

Henry E. Bromer, resident manager of The Decatur Casting Co., Decatur, Ind., died April 26 after a long illness. He had been associated with the company for 22 years.

Mr. Bromer studied metallurgy at Carnegie Institute of Technology. He then became affiliated with Jones & Laughlin Steel Co., Pittsburgh.

From 1927-1935 he was in charge of metallurgical and melting facilities at Standard Foundry Co., Racine, Wis.

Prominent in business, civic and church activities locally, Mr. Bromer was a member of AFS and was serving on the Safety, Hygiene and Air Pollution Control Steering Committee.

Edward E. Hook, vice president of Dayton Oil Co., Dayton, Ohio, died June 6. He was 64 years old. Prior to joining the Dayton Oil Co. in 1943, Mr. Hook was connected with American Radiator Co., Buffalo, N.Y., and Pierce Butler Radiator Corp. of Syracuse, N.Y. He served as chairman of the Central New York Chapter of AFS in 1946-47 and as director of that Chapter from 1947-1950.

Fred W. Busche, 64, president of General Foundries Co., Milwaukee and Falls Foundry Co., Menomonee Falls, Wis., died May 26 of chest and head injuries suffered in an accident at the Menomonee Falls plant when a heavy piece of machinery, which was being installed, slipped and pinned him to the floor.

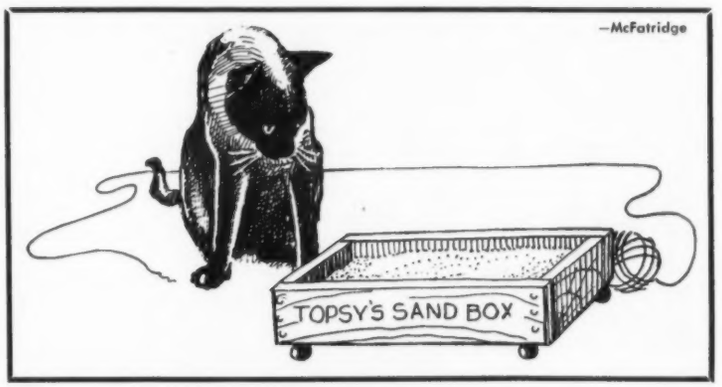
A member of AFS, Mr. Busche also held memberships in Wisconsin Masonic Lodge, Tropoli Shrine, and other civic and social organizations.

Albert W. Bloom, 48, general supervisor of core rooms at Caterpillar Tractor Co., Peoria, Ill., died recently. He had been associated with Caterpillar Tractor Co. for over 25 years and was a member of the Central Illinois Chapter of AFS.

Stanley B. Wentz, 66, president of Pennsylvania Foundry Supply & Sand Co. and treasurer of Pennsylvania Chaplet Co., Philadelphia, died May 29 of a heart attack. He was one of the founders of both companies and connected with the industry over 40 years. He was a member of the Philadelphia Chapter of AFS.

VOLCLAY BENTONITE
NEWS LETTER No. 52
REPORTING NEWS AND DEVELOPMENTS IN THE FOUNDRY USE OF BENTONITE

What's in YOUR Sand?



Even "Topsy" is particular about her sand. Do you check your sand for too much contamination?

Every sand system, particularly a closed system, should have routine checks to **study contamination in the molding sand.**

Molding sand is continually contaminated by cores. These compounded core sand grains can cause untold damage to casting finish.

Sloppy pouring produces shot. If this shot is not properly removed from the sand, casting finish is greatly affected.

Gaggers, core wires, soldiers, and similar contamination can enter the molding sand and cause damage to both patterns and casting finish.

The molding sand system is no place for cigarette butts or chewing tobacco, but few systems are without this type of contamination. If the sand is contaminated, there is only one cure, either clean it or use a facing against the pattern.

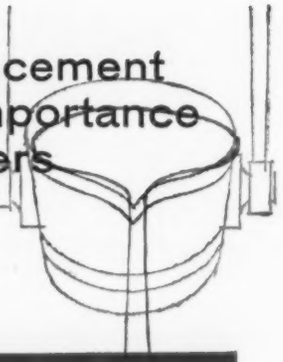
A preponderance of fines is said to be harmful, but **a certain amount of fines is necessary.** There are many contaminating materials that find their way into the molding sand and if they are not properly removed, the molding sand becomes unfit for molding practice.

• **Write for *"New Brochures"* . . . just off the press.**

AMERICAN COLLOID COMPANY
Chicago 54, Illinois • *Producers of Volclay and Panther Creek Bentonite*

Circle No. 155, Page 7-8

An Announcement of Great Importance to the Buyers of Foundry Equipment



affco

C. E. "Joe" Boettcher, formerly sales manager of the flask division of Black, Sivalls and Bryson, has been appointed to the same position with American Foundry Flask Company. Mr. Boettcher's engineering and sales experience in the flask field are well known. American Foundry Flask will maintain the same lines of distribution that Black, Sivalls and Bryson previously used.

AMERICAN FOUNDRY FLASK COMPANY

The American Foundry Flask Company, a division of Cromb and Gagel, Inc., Kansas City, Missouri, announces the purchase of the sales and manufacturing rights to the "Perfection" or "BS&B" flask line made for over thirty years by Black, Sivalls and Bryson of Kansas City, Missouri.

This purchase included equipment, inventory, engineering data and all factors pertaining to the flask division of BS&B.

The same high quality, expert craftsmanship and engineering excellence previously found in this fine line of flasks will be continued, according to A. H. Cromb, president of the newly formed company. "Black, Sivalls and Bryson have set a wonderful and challenging record for us to meet and beat," said Mr. Cromb. "We are determined to both meet it and beat it."

affco **AMERICAN FOUNDRY FLASK CO.**

2745 SOUTHWEST BLVD., KANSAS CITY, MO.

Circle No. 157, Page 7-8

John W. Bolton Receives A.S.T.M. Award of Merit

■ Outstanding work in gray iron has won the American Society for Testing Materials Award of Merit for John W. Bolton. The award was made at the annual meeting in June at Atlantic City, N. J.

Mr. Bolton, now retired, has been active in American Foundrymen's Society activities and formerly was chief metallurgist, Lunkenheimer Co., Cincinnati. In 1937 he was awarded the AFS John A. Penton Gold Medal award in recognition of his work in metallurgy and the practical application of research findings to the advancement of the foundry industry. In 1943 he was the AFS Hoyt Memorial lecturer. For many years he was active in the AFS gray iron and brass and bronze divisions.

Among his papers given at AFS conventions are *"Graphite in Gray Iron," "Notes on Composition and Structure of A.S.T.M. Bar," "Some Graphite Formations in Gray Cast Iron,"* and *"A.S.T.M. Specification A48-32T."* In addition he authored the book *"Gray Cast Iron,"* and was active in preparing various AFS publications.

MIT To Offer Course For Investment Casters

■ A week-long course on investment casting will be conducted Sept. 9-13 at the Massachusetts Institute of Technology, Cambridge, Mass. The course, which will be under the direction of Professors Nicholas J. Grant and Howard F. Taylor, will include lectures, laboratory exercises, and demonstrations.

Subjects to be covered include investment materials; melting; gating; risering; solidification and heat transfer; metal and alloy systems; defects in castings; and consideration of new investment and allied processes.

Casting Institute Elects

■ F. M. Fahrenwald, Fahralloy Co., Harvey, Ill., was elected president of the Alloy Casting Institute at the annual meeting held during June at Hot Springs, Va. Paul L. McCulloch, Jr., Electro Alloys Div., American Brake Shoe Co., Elyria, Ohio, was elected vice-president. E. A. Schoefer, Mineola, N. Y., was reelected executive vice-president and treasurer. New directors are Frank Kiper, Michigan Standard Alloy Casting Co., Detroit, and J. B. Dear, Duraloy Co., Scottdale, Pa.

PQ SODIUM SILICATE SERVICE

PRODUCTS

Over 40 silicates (liquids, solids, hydrated and anhydrous powders). You get the right one for your particular process.

USES

Sealants for porous castings, binders for cements, detergents for metal cleaning, coagulant aid for water treatment.

SERVICE

From nine plants, Anderson, Ind.; Baltimore, Md.; Buffalo, N.Y.; Chester, Pa.; Jeffersonville, Ind.; Kansas City, Kansas; Rahway, N.J.; St. Louis, Mo.; Utica, Ill. Distributors in over 65 cities.

CONSULT WITH US ABOUT YOUR SILICATE NEEDS.

PHILADELPHIA QUARTZ COMPANY
1125 Public Ledger Building, Philadelphia 6, Pa.

TRADEMARKS REG. U.S. PAT. OFF.

PQ SOLUBLE SILICATES

M. HOLTZMAN METAL CO.

SMELTERS AND REFINERS

SINCE 1900

HOLMCO

GUARANTEED Brass, Bronze and ALUMINUM INGOT to your specifications IMPROVED WITH FACTOR "X"!

Send us a sample order! If you want to improve the quality of your finished products at no additional cost . . . let us show you what HOLMCO ingot, improved with Factor "X" can mean to you!

5223 McKISSOCK AVE., ST. LOUIS, MO.

CHestnut 1-3820

Circle No. 159, Page 7-8

foundry trade news

Precision Castparts Corp. . . has completed a 21,000 sq ft plant at Portland, Ore., for an investment casting and shell molding foundry. The firm specializes in the production of alloy and stainless steel castings for aircraft, missile, and electronic components.

General Electric Co. . . has installed a gas-fired car-bottom furnace at its Schenectady, N.Y., plant. The unit, constructed by the General Electric Industrial Heating Department, is used to stress relieve large castings. The furnace has handled loads as large as 150 tons.

American Brake Shoe Co. . . has relocated its New York offices at 530 Fifth Avenue, New York 36, N.Y.

Griffin Wheel Co. . . will build a cast steel railroad car wheel plant in Muncie, Kan., near Kansas City. Construction will begin immediately and will be completed in the fall of 1958. Capacity will be 120,000 wheels annually.

Alloy Precision Castings Co. . . will enlarge its Cleveland plant to double existing facilities by the end of 1957.

Thys Co. . . Sacramento, Calif., steel foundry has opened a sales and engineering office at San Leandro, Calif., to serve the San Francisco Bay area.

Indiana Products Co. . . foundry supply house has moved its headquarters to 1611-17 South Lafayette St., South Bend, Ind., after 41 years in business at Kokomo, Ind.

Fire Brick Service Co., Inc. . . Jeffersonville, Ind., firm has been named as an outlet for the refractory products of Mexico Refractories Co.

Fredinand G. Schultz Co. . . Pittsburgh, Pa., firm has been appointed a sales representative of Detroit Electric Furnace Div., Kuhlman Electric Co.

Shaw Process Development Corp. . . Port Washington, N.Y., firm has announced the licensing of four firms to use the Shaw Process of investment casting. The firms are: Precision Plastics, Philadelphia; Star Foundry, Ft. Wayne, Ind.; General Mold Castings, Newark, N.J.; and Ross Meehan Foundry, Chattanooga, Tenn.

Keener Sand & Clay Co. . . Columbus, Ohio, firm has purchased the business of Industrial Minerals Co., Lancaster, Ohio.

Great Lakes Carbon Corp. . . has started construction of a research and development pilot plant at Niagara Falls, N.Y.

E. F. Houghton & Co. . . oil, chemical, and packing manufacturer will expand its facility in Detroit to more than double present size.

Bristol Co. . . instrument builder has opened a branch factory and repair laboratory in Houston, Tex. This branch plant will service the firms recording instruments in service in southwestern industries.

Samuel Greenfield Co., Inc. . . Buffalo, N. Y., firm has been appointed an ingot distributor for Kaiser Aluminum & Chemical Sales, Inc.

Ajax Flexible Coupling Co., Inc. . . has completed an 11,000 sq ft addition to its plant at Westfield, N.Y.

Baird-Atomic, Inc. . . has opened three new district sales offices in the Philadelphia, Atlanta, and Cleveland areas. Addresses of the new offices are: Old Lancaster Road, Berwyn, Pa.; 620 Jay St., Sandusky, Ohio; 1447 Peachtree St., N.E., Atlanta, Ga.

Great Lakes Carbon Corp. . . has completed a new office building at the Niagara Falls, N. Y. plant of its Electrode div. New building is part of firm's drive to increase production of graphite items by 45 per cent.

Canam Metallurgical Sales Co. . . is a new organization formed by R. A. and N. F. Tisdale, Jr., to distribute and develop ferro-alloys. The new company is exclusive sales agent for several Canadian nickel interests. Headquarters are the Grant Building, Pittsburgh 19, Pa.

New England Smelting Works, Inc. . . West Springfield, Mass., firm has been appointed an ingot distributor for Kaiser Aluminum & Chemical Sales, Incorporated.

Electro Refractories & Abrasives Co. . . has appointed Rex Tool Co., Inc., Milwaukee, as its distributor in the Milwaukee area.

Baldwin-Lima-Hamilton Corp. . . has opened a sales office at Schenectady, N. Y., for its Standard Steel Works Division and for its Electronics and Instrumentation Division.

Madison-Kipp Corp. . . Madison, Wis., manufacturer of die castings has received an award from its insurance carrier for its record of one million man-hours' operation without a disabling injury.

Hewitt-Robbins, Inc. . . is building a 60,000 sq ft plant for the production of industrial wire cloth and wire mesh conveyors at King-of-Prussia, Pa. The building will be completed in September.

Bristol Co. . . Waterbury, Conn., firm has opened a branch factory and repair laboratory for its controllers and recording instruments at Los Angeles.

Employees of iron and steel foundries recently organized two more cooperative credit unions according to the Credit Union National Association. Employees of the **Wheland Co.**, Chattanooga, Tenn., and employees of the **L. R. Heat Treating Co.**, Newark, N. J., have organized the new groups.

OLIVER SURFACERS
for pattern shops

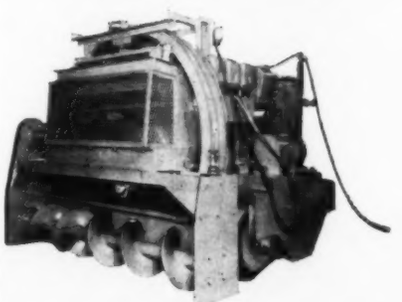
Planes smooth, accurate patterns at lowest cost

Surfaces stock up to 24" wide, 8" thick. Parts are permanently aligned. Rate of feed controlled by hand dial. Built-in knife grinding and jointing rig. Write for Bulletin No. 229.

Oliver makes 18", 30", 36" Surfacers . . . and all woodworking machines needed for pattern shops

OLIVER MACHINERY COMPANY
Grand Rapids 2, Michigan
Circle No. 160, Page 7-8

STOP "KICKING" YOUR SAND AROUND and give it RINGLIFT Conditioning!



The RINGLIFT Sand Conditioner gets all sand up off floor, screens, magnetically separates, aerates, cools, adds moisture, mixes, and deposits in neat windrows. Velvety, open sand that assures much better castings. Real economy — up to a ton of sand per minute. Get a user's opinion! Send for bulletin.

STATES ENGINEERING
CORPORATION
924 W. Berry St.
Fort Wayne, Indiana
Circle No. 161, Page 7-8

THE RIGHT ALLOY FOR ANY FOUNDRY NEED

ELECTROMET offers a complete line of ladle and cupola addition agents

Additions of ferro-alloys will adjust the composition of the base iron to make it suitable for the particular work on hand. You can reduce chill in thin-sectioned castings or improve strength and machinability. You can, if desired, increase hardness and improve resistance to wear and heat-all through the simple addition of alloys. And there's an ever wide variety of ELECTROMET alloys to choose from.

ELECTROMET not only has the alloys to meet your needs, but also furnishes technical assistance in their most effective use. Please phone or write the ELECTROMET office nearest you for detailed information on these or other ELECTROMET products.

ELECTRO METALLURGICAL COMPANY, Division of Union Carbide Corporation, 30 E. 42nd Street, New York 17, N.Y. *In Canada:* Electro Metallurgical Company, Division of Union Carbide Canada Limited, Toronto.

METALS DO MORE ALL THE TIME . . . THANKS TO ALLOYS

Electromet
FERRO-ALLOYS AND METALS

UNION CARBIDE

ALLOYS FOR LADLE ADDITIONS

Ferrosilicons (50%, 75%, 85%, and 90%) In grades and sizes suitable for all conditions in the iron foundry. Silicon reduces chill in thin-section gray iron castings.

"SMZ" Alloy—A strong, super-graphitizing alloy and chill reducer. Contains zirconium and manganese to enhance the inoculating properties.

Calcium-Silicon—Inoculant for reduction of chill and for developing high-tensile strength. Especially suited for use in low carbon-equivalent irons.

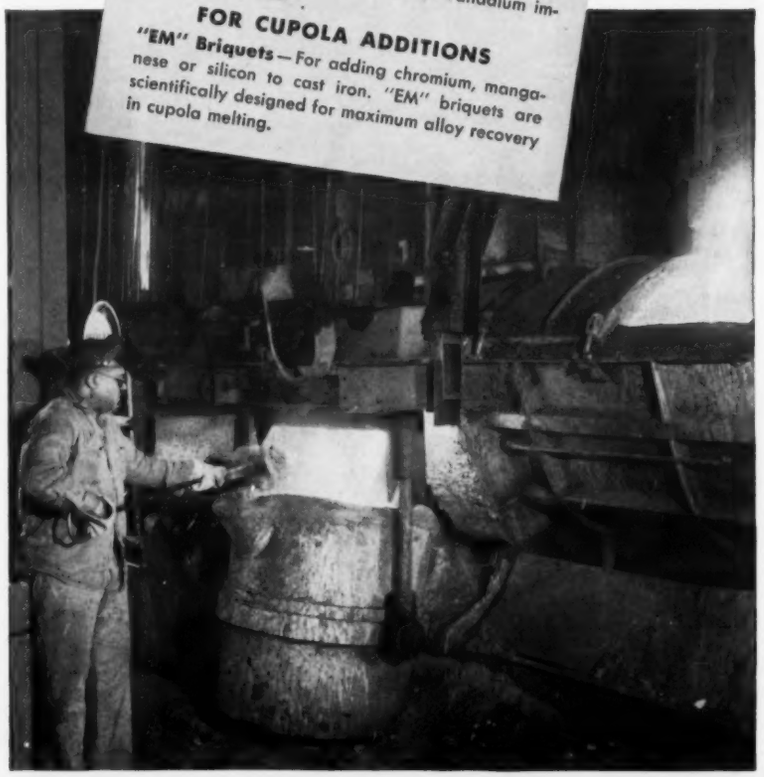
Zirconium Alloys (12 to 15% and 35 to 40%) Graphitizers for reducing chill, aiding machinability, and improving tensile properties.

Ferrochromium Alloys—Available in many grades for cast iron. All grades have rapid solubility. Widely used to improve the hardness, strength, and heat and wear resistance of cast iron.

Ferrovanadium—ELECTROMET foundry grade ferrovanadium has good solubility. Vanadium improves toughness.

FOR CUPOLA ADDITIONS

"EM" Briquets—For adding chromium, manganese or silicon to cast iron. "EM" briquets are scientifically designed for maximum alloy recovery in cupola melting.



Nation-wide service through these conveniently located offices:

Birmingham • Chicago • Cleveland • Detroit • Houston
Los Angeles • Phillipsburg, N.J. • Pittsburgh • San Francisco

The terms "Electromet," "EM," "SMZ" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Circle No. 162, Page 7-8

patent review

MELVIN NORD, *Dr. Eng. Sci., LL. B*
Consultant in Law and Engineering

Cure Shells in 30 Seconds

Shell molds can be cured in 30 seconds or less by using a method which places the shell in contact with a hot fluidized bed.

The bed is sand, shot, or similar material and it is placed in a container on a porous ceramic membrane. Hot air fills an air chamber in the container, penetrates the membrane and fluidizes the bed and maintaining it at an elevated temperature.

The pattern and shell are lowered into the bed to bring all external surfaces of the shell into contact with the bed. 2,771,648, *issued Nov.* 27, 1956 *to Emery L. Valyi.*

Sand Mix for Fine Finish

A new method of preparing shell molding sand produces thin-walled molds and cores with exceptionally smooth surfaces.

Specially prepared sand-resin mixes are used, in which the refractory filler is composed of two constituents with widely different screen analyses, each having fairly uniform particle size. A mixture of silica flour, sand, and binder permits the production of shell molds with exceptional surface smoothness (due to the silica flour) and strength and hardness (attributable to the sand.) 2,772,458 *issued Dec.* 4 *to Donald J. Henry and assigned to General Motors Corp.*

Flask Conversion

Flasks of conventional design can be converted for use in a mechanized molding line by adding a bumper at forward and rear ends of the drag. Bumpers permit flasks to be moved without difficulty on curved track. 2,772,456, *issued Dec.* 4, 1956 *to John A. Lasater and Thomas A. Deakins and assigned to Combustion Engineering Co.*

AFS Tentative Standard

Collapsibility Test for Shell Molds and Cores Used With Light Metals

Before a casting goes into production, the foundry should know whether the shell cores and molds planned for this casting will have sufficient collapsibility and inhibitor effectiveness, and whether they will produce the required casting surface quality.

Conventional shell mold and core mixtures, used for higher temperature melting alloys, are not usually satisfactory for light metal castings. Light metal castings lack sufficient heat to promote core collapsibility, particularly when the casting has thin sections.

AFS Light Metals Division Shell Molding Committee has devised a test to determine the relative collapsibility of various sand and binder mixtures before the sand is used in the production of shell molds or cores. This test involves pouring a test casting into which a standard shell mold tensile briquet is cast-in. This test casting can be examined to evaluate inhibitor effectiveness and casting surface quality.

While this test proposes specific procedures and equipment, the principles of the test may be adapted to local conditions for relative testing.

Test Specimen

The specimen of material should be a standard shell mold tensile briquet. Procedure for preparation of this briquet is detailed in the article "AFS Tentative Standard Tensile Test for the Control of Shell Molding Sand Mixtures," Modern Castings, Dec. 1955, pp. 69-70.

The drawing used in making the mold for this test is shown in Fig. 1. A completed pattern is shown in Figs. 2 and 3.

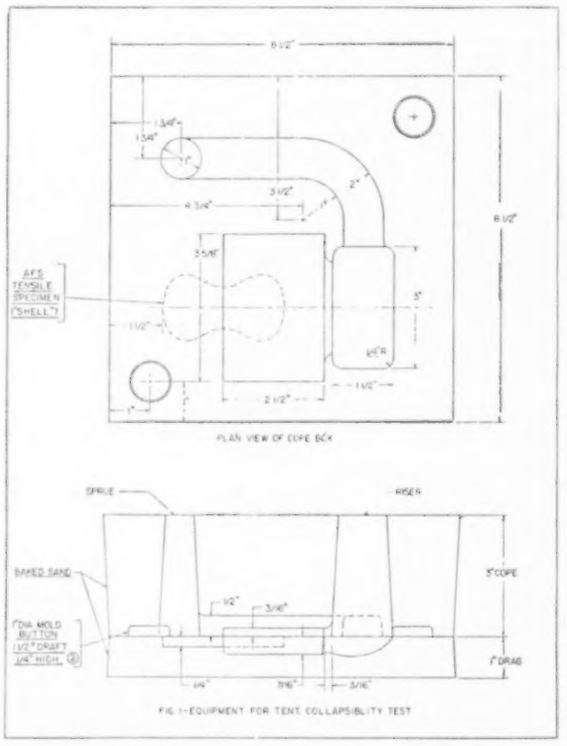


Fig. 1 . . Pattern and mold for collapsibility test.

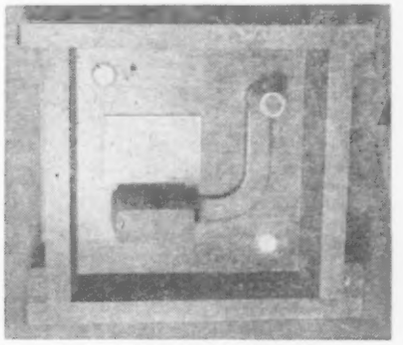


Fig. 2 . . Cope pattern.

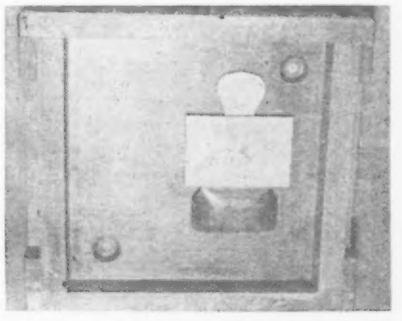


Fig. 3 . . Drag pattern.

Any sand mixture suitable for the metal to be cast may be used in making the mold. After preparation of the mold, position a representative tensile test specimen in the drag print, smooth surface down, and assemble the mold halves for pouring. If casting magnesium, the mold may be flushed with sulphur dioxide gas before pouring.

Pouring

The assembled molds should be positioned level for pouring. Pouring should be done at closely controlled temperatures; i.e. 1400 ± 10F for magnesium, or 1300 ± 10F for aluminum alloys. A uniform rate of fill and a uniform pouring height must be maintained. The downsprue must be kept filled at all times. Shakeout of the test casting (Fig. 4) should be accomplished without disturbing the cast-in test specimen.

Testing the Casting

The test casting resulting from this procedure, can be used as follows:

- **Collapsibility.** The number of blows or the time required to remove the sand briquet from the casting can be taken as an index of collapsibility. The time limit should be of sufficient magnitude to distinguish between different mixtures. Equipment for the shakeout can be a core knock-out machine or an impact tester.
- **Inhibitor effectiveness.** Cut the test block as shown in Figs. 5 and 6. The pieces of the block formed against the tensile specimen will indicate the relative effectiveness of various inhibitors used. Inspection of the surface formed against the smooth face of the tensile bar will indicate desirable inhibitors.
- **Optimum production conditions.** By variation in time-temperature relationships for preparing the tensile test specimens and in the pouring temperature and conditions selected, some indication may be determined regarding production conditions for casting production.
- **Casting surface smoothness.** The test block cut to check on inhibitor effectiveness will also reveal the relative character of the metal surface that can be obtained for the particular shell mold or core sand mixture from which the tensile specimen was made.

Committee

Members of this committee were: N. Sheptak, chairman; J. E. Bolt, vice-chairman; J. L. Schmeider, Jr.; G. A. Conger; R. E. Daine; R. J. Graber; R. A. Hagstrom; F. W. Less; Lee Stark.

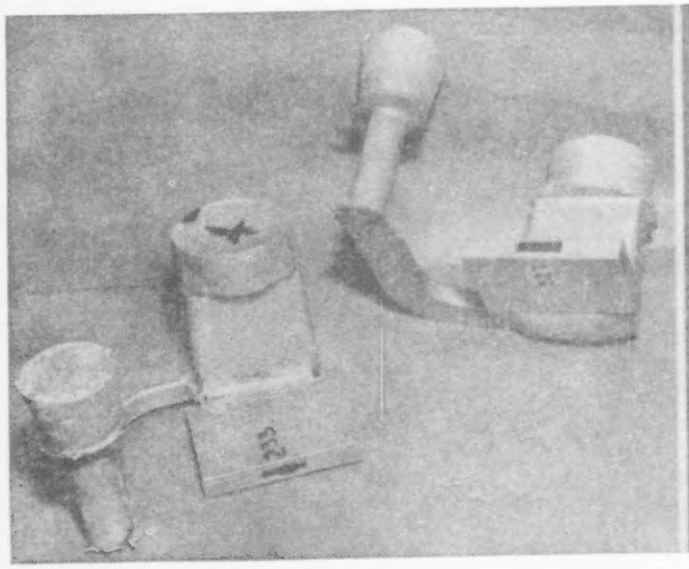


Fig. 4 . . Dark slot in casting is the cast-in sand specimen.

Fig. 5 . . Test casting marked for cutting.

Fig. 6 . . Sample removed for evaluation.

dietrich's corner

by h. f. dietrich

When we think of the Old Timers, we can give the title, "King of the Vulcans," to only one man, Andrew Carnegie. Actually little Andy seldom got close enough to the little hells of smoke, flame, and sudden death that he created, to singe his goatlike beard or dirty his number five shoes.

The little Scotsman was a Horatio Alger character in the days when one-eyed molders were as common as horse flies. With Scotch thrift he saved enough of his pay as messenger boy at age 14 to buy into a bridge building company. Railroads—real, and on worthless paper—were being pushed all over the country, and Andy got in on the ground floor. By adroit manipulation, this supersalesman managed to parlay an executive ability, a few assorted riots, a little sabotage, (never satisfactorily proven) some false advertising, and a couple of iron works into a mammoth corporation.

The cocky executive knew little about iron, but he knew how to hire men who could get the job done. His first venture into the molten metal game was buying into the Kloman brothers' works with money borrowed from his brother Tom; Miller, a railroad P. A.; and a money juggler called Phipps.

But the 130 pound traveling salesman had ambitions. After two years he felt that the gifted Carnegie brothers should run things to suit themselves. By pessimistic propaganda, he bought out the stock of Miller and Phipps. He had to be number one man. The Kloman brothers were iorn mongers par excellence and didn't object to the efficient salesmanship of the man who kept orders coming into the plant. The panic of 1873 allowed Andy to freeze the Klomans out of the partnership. During the panic, it was the liquid capital at the command of William Coleman, Carnegie's father-in-law that kept the business solvent.

Acquiring a plant here and there, plants that seemed to need money when Carnegie wanted them, he built up a loose organization with a hard drinking, club swinging work force who swore in 23 languages and dialects. It was a crew in which the men were men, and the women must have been too.

Andy was always a little late getting into a new process. As an example, he failed to see the potential of Bessemer steel. Although urged by brother Tom and his father-in-law to invest, Andy dissented. After Tom and Coleman proved that Bessemer steel was a paying process, the little hedge-bettor got in with both feet.

When competitors started the Pittsburg Bessemer Steel Company, they had trouble on their hands from the start. Strikes, sabotage, and riots dropped the price of their stock until it was low enough for Andy to buy control, and it became Carnegie's Homestead Mill.

When Duquesne gave him trouble by making better rails by a new and cheaper process, Andy started a whispering campaign about the wrecks caused by the new rails. Duquesne couldn't run without orders, and their stock dropped to where Carnegie could buy control. After that, Andy convinced the trade that the new process rails were the best.

Carnegie didn't think much of the shanty towns created by his enterprises. Nor did the pall over Pittsburg, caused by his money-making machines, appeal to him. He felt, as did his idol Spencer, that the atmosphere of the steel center would justify suicide. By hiring such men as Skelding, who handled profanity as a fine art and blasted the chill from the "Lucy" with a siege mortar; Captain Bill Jones, a steel master supreme who walked among his rough and ready crew with authoritative fists, and finally died in a slag pit with his boots on; and Frick, the Coke King who consolidated the Carnegie holdings with an iron hand, Andy could run his empire from the throne room of a New York hotel.

From 1867 when this five foot inch industrial giant gained control of the Union Iron Mills, until 1900 when he sold out to the J. P. Morgan interests, Carnegie kept his empire of sparks, smoke, and flame supplied with orders. To him, the building of this empire must have become an obsession. In the next issue of MODERN CASTINGS I will try to justify his existence.

Prevent scrap Aluminum Bronze castings

like this

by using

Foseco®

ALBRAL

Foseco ALBRAL will PREVENT oxide inclusions *like this* in aluminum, manganese and silicon bronzes. Foseco ALBRAL is a flux, scientifically prepared, to reduce oxide formation and remove non-metallic inclusions in these alloys.

Although bronzes containing aluminum, manganese or silicon do not have to be deoxidized in the usual meaning of the word, a final treatment with Foseco DEOXIDISING TUBES before pouring is beneficial. This treatment will coalesce finely dispersed oxide particles causing them to float to the surface of the melt where they can be skimmed off.

ADVANTAGES of using Foseco ALBRAL and DEOXIDISING TUBES

- *harmful oxides of aluminum, silicon and manganese are removed and their formation prevented*
- *a protective cover forms over the melt, reducing oxidation and zinc fuming*
- *the fluidity and feeding properties of the alloy are increased and the pressure tightness and mechanical properties of the castings are improved*
- *dross formation reduced and crucible build-up is stopped*
- *the composition of the alloy is not altered in any way*
- *skimmings low in metallic content are obtained*

Prevent scrap castings. Clip and mail the coupon now and we'll send you complete information on Foseco ALBRALS and DEOXIDISING TUBES explaining how to use them in your foundry.

FOUNDRY SERVICES, INC.

2000 BRUCK STREET COLUMBUS 7, OHIO

In Canada: FOUNDRY SERVICES (CANADA) LTD., 201-7 Alice St., Guelph, Ontario

Send this coupon for your free leaflets giving all the facts on Foseco ALBRALS and DEOXIDISING TUBES.

Name_____

Company_____

Address_____

City_____ State_____

Circle No. 163, Page 7-8

Large and intricate cores are cured in minutes with the

New Sodium Silicate-CO_2 Process

Elimination of oven baking speeds production ...cuts costs

Only a few minutes are required to cure green cores when the new sodium silicate-carbon dioxide process is used. Cores and molds are ready for the metal pouring line immediately after CO_2 curing. No time-consuming oven baking is required. The production cycle is faster . . . costs are lower.

In one foundry, six baking ovens were scrapped after the sodium silicate-CO_2 technique was given a trial. Another foundry reports that an overall cost saving of 21% has been achieved since switching from oven curing to the CO_2 process.

In addition, foundries using the new system find that CO_2-cured cores resist breakage, hot tears and cracks . . . can be made to extremely close tolerances. Foundry personnel like the new process because it has no toxic fumes or objectionable odors.

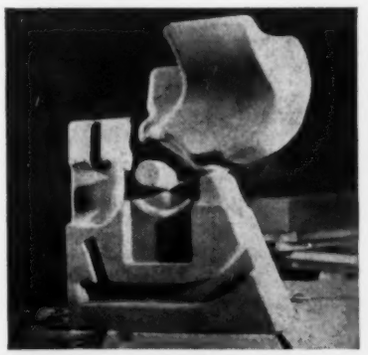
High-quality Du Pont sodium silicate is available in formulated products for CO_2 systems from foundry supply houses throughout the country.

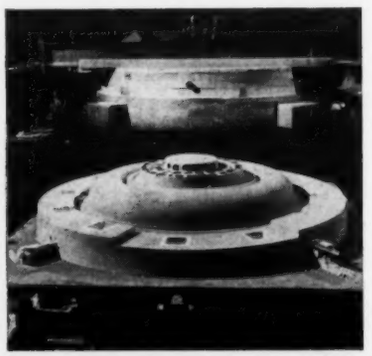
Binder formulations vary for specific needs and foundrymen prefer to rely on the advice of their foundry supply representatives for recommendations.

E. I. DU PONT DE NEMOURS & CO. (INC.)
Grasselli Chemicals Department
Wilmington 98, Delaware

Fine core sand and a binder based on Du Pont sodium silicate are mixed thoroughly in a standard muller (left). Mixture is hand-tamped into form (right) then packed tightly with pneumatic rammer.

Core maker prepares to inject core with carbon dioxide (left). In the chemical reaction that results, the silicate is converted into a strong gel that binds sand grains together firmly. Cured core (right) is strong, yet will collapse easily after casting.





Intricate core for an automotive casting (left) is cured and ready for the metal pouring line in 2 to 3 minutes. Core for large industrial torque converter (right) is cured and ready for use in a few minutes. Oven curing would take several hours to do same job.

DU PONT
REG. U. S. PAT. OFF.

SODIUM SILICATE

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Circle No. 164, Page 7-8

Ability to Lower Costs Speeds Plastic Growth

Information in this article is abstracted from a talk entitled "New Opportunities for Pattern Makers," presented at the East Coast Regional Foundry Conference, April 12-13 by M. K. Young, U.S. Gypsum Co., Chicago.

■ Match plates, core boxes, patterns, and cope and drag equipment represent the best opportunity in foundries today for use of plastics. It has been justly said that plastic pattern fabrication is making possible new products that might have formerly died on the drawing boards or in the design stage. It is a tried and true method and the savings in time and money has been recognized by the industry.

In many situations it is difficult to justify expensive patterns, dies, and tools. Job shops have made it possible to tool up these low production jobs by the use of gypsum cements and plastic resins. With these materials, original patterns can be made in one-fourth to one-third the time required by traditional patternmaking methods.

A good example of lower pattern and tool cost is illustrated in a recent talk given by a vice-president of one of the large automotive concerns.

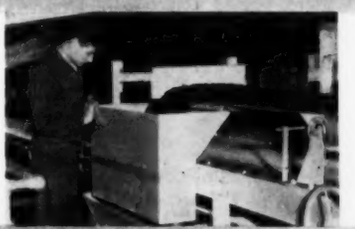
The decision was made by the company to introduce a new model. Since it was a new design, there was no way of forecasting sales. Therefore, it had to be produced in moderate quantities. Plastics were selected and used for patterns, dies, and fixtures wherever possible. Every body panel for this model was stamped-out on plastic dies because of the reduced cost for die fabrication.

A steel die to form the roof panel made by machining steel was estimated to cost about $100,000. The plastic die to do the same operation was made for $30,000. Since there is little machining required, the pattern shops are now doing the work which was formerly given to the tool and die shops—a fine opportunity for the pattern industry.

In addition to low cost, plastic patterns, core boxes, dies, and models can be made in less time. This means that new automobiles, refrigerators, and other appliances can be introduced months ahead of models made from steel dies. Plastic patterns and tools are also lighter in weight and require no expensive machinery or equipment to fabricate.

Plastic patterns or core boxes can be repaired quickly with the same plastic from which it was fabricated. Wood patterns can also be repaired by patching them with epoxy resin and fiber glass cloth.

continued from page 32

Operation	Observation	Evaluation	Mechanization
Baked core delivery	After cores have been baked, they are allowed to cool overnight. Since the plant has a shortage of core racks, the cores are removed early in the morning and placed on the floor. As the cores are needed in the molding department a core delivery man, equipped with a two-wheel core tray cart, picks up the needed cores and proceeds to the molding area. Upon arrival at the molding area, the cores are stacked on the floor. Breakage is terrific, not to mention the confusion in finding the correct cores.	**Provide** a sufficient number of *racks* so cores will not have to be placed on the floor. After cores are cleaned and assembled, replaced on racks and transported by fork lift truck to molding area, racks would be allowed to remain until cores are used. Empty racks would be returned for re-use. This would greatly speed handling, reduce breakage, and reduce the confusion in locating correct cores (assuming, of course, that our scheduling is functioning correctly). **Provide** sufficient racks as above, however, use a *low-lift walkie truck* to transport the rack. This provides the same advantages as above.	The electric low-lift walkie-platform truck used for green core delivery should also be used to mechanize bake core delivery. Mechanization of these operations is thus accomplished with minimum capital outlay while reducing the handling problem to full-time assignment for one man.
Cupola Charging	The master flow chart shows that a 20 to 25 ton a day melt costs five man-days in the preparation and charging of the cupola. Present method of charging is as follows: Early in the day, prior to lite off, four men and a crane operator are employed in raising coke and metal to bins located on the charging floor. This requires about 3 to 4 hours per melting day. After the cupola is bedded in, the four men are employed in charging the cupola with wheelbarrows. The crane operator supervises weighing and recording for the balance of his 8-hour shift.	**Re-design** the charging system as follows: Remove present bridge crane (bridge portion only); suspend a *monorail system* running in front of material bins; suspend a motorized weight trolley from monorail. As drop-bottom buckets are charged (2 men), items would be weighed. Provide a monorail crane (1 operator) on the charging floor level, this to pick up bucket, run into cupola and charge. This would result in about a 12 man-hour charging cost. **Make no change** in bridge crane arrangement, however, provide a scale for crane-hook and *drop-bottom buckets*. Use two men to charge buckets on ground level, weighing materials as they are placed in bucket. Crane operators would move the bucket from bin to bin, and after it is full, to the charging floor. On the charging floor construct a simple monorail and counter-balance electric lift. A fourth man will pick up the charged bucket, run it into the cupola, discharge and return the bucket. This arrangement would result in about a 16 man-hour charging cost.	Although the re-designed system will result in the greatest savings and will permit a greater cupola charging capacity, if needed, the new scale and monorail arrangement does not require as great a capital outlay and does afford a reasonable reduction in manpower.
Molding **Sand handling**	The master flow process chart shows that an excessive amount of time is spent transporting molding sand from the muller (a distance of about 150 ft) to the jolt-squeeze machines. About 50 per cent of molding labor is spent shoveling sand into flasks. The present operation is as follows: Molding sand is discharged from the muller into bins located on either side of the muller. Two tractor-shovels pick up the sand and deliver it to an area between the cope and drag machines. Each operator (4 operators) shovels sand into his flask and tops it off with about 50 per cent back-up sand. As the windrow of back-up sand is used, a tractor-shovel pushes additional sand forward to the molding machines. Two tractor-shovels are running a full 8-hour shift on the first shift, plus one tractor-shovel on a full second shift. This results in 24 man-hours of tractor-shovel operation time devoted exclusively to handling sand. Not only is this an extremely expensive handling operation, but it also results in roughly 50 per cent down-time for the jolt-squeeze machines.	**Install** an *overhead sand system*, including mechanical shake-out, screening operation, greater capacity muller, bucket elevator and overhead belt conveyor running to sand hoppers over molding machines. Although this will represent a considerable capital outlay, it will completely eliminate the 24 hours of sand handling by tractor-shovel and allow the operators to spend just about full-time producing molds. It will also permit the preparation of all molding sand. **Install** *holding hoppers, bucket elevators,* and *overhead bin hoppers* at each of the four jolt-squeeze units. Installation would cost substantially less than the suggestion above. Tractor-shovel would continue to deliver sand to the holding hoppers, however, by eliminating the shoveling by the operators, production could just about be doubled.	The overhead sand system is recommended as the mechanized solution. This is the more expensive solution, but it will result in improved sand practices. In addition, this solution frees two tractor-shovels for other work. One would be used to unload new sand and the other unit could be sold. 

please turn page

continued from page 77

Operation	Observation	Evaluation	Mechanization
Flask handling	The pour-off bays in front of each of the plant's two units of jolt-squeeze, cope and drag machines, are approximately 130 ft long and 30 ft wide. Each evening as the molds are shook out, by using shakeout bails suspended from bridge cranes that covers the entire area, flasks are stacked on the wall side of the bay. The result is that flasks are stacked four to five high, an average distance of 65 ft from our molding machines. As each flask is called for, it must be picked up by the bridge crane and hand propelled to a jolt-squeeze machine. Since an average of 200 molds are made each day, flasks must be moved approximately 13,000 ft during production. Consequently, about 16 man-hours are spent just to procure and position flasks, plus the confusion and unsafe conditions that result from the method.	**Purchase** a 4000 lb. capacity *fork lift truck* and several hundred 48 x 48-in. wood pallets. An average of 8 cope and drags could be carried on this pallet. As molds are shook out, flasks would be segregated by size and placed on pallets. The palletized flasks would then be stacked along the side of the molding bay. During production, a fork lift truck would move these unit loads of flasks to the jolt-squeeze machines. This will reduce the distance flasks are moved to approximately 3250 ft, and because of the faster service with fork truck, it will be done with 2 man-hours of labor and fork truck time. **Provide** a pour-off *roller conveyor* and a powered storage return flask conveyor. This would require about 2500 ft of gravity roller conveyor and 2500 ft of powered conveyor; however, for all practical purposes, it would eliminate the present labor handling.	**The fork lift is suggested since it will substantially reduce the handling to the lowest possible cost. Because the fork truck will not be utilized full-time, it may also be used to unload palletized unit loads of bagged material, thus solving that problem. There should still be sufficient available time for miscellaneous handling of waste materials.**
Cleaning	After castings have cooled sufficiently they are placed in four-wheel carts. These carts are hand propelled to a core shakeout area adjacent to the blasting equipment, a distance of 450 ft. As the castings have their cores removed they are stacked in piles adjacent to our barrel blast equipment. In the morning each casting must be picked up individually and placed in a skip hoist bucket and loaded into the blast cleaning equipment. Following blast cleaning, the castings are allowed to fall either into a tote box or onto a skid. Since the plant has only two substantial tote boxes and two or three substantial skids, castings must immediately be removed and placed in piles on the floor. Each grinder operator, with the aid of an overhead bridge crane, individual jibs, or hand propelled four-wheel carts, procures sufficient castings for several hours work. On completion of chipping and grinding, each operator, with the aid of the above mentioned equipment, transports the finished casting to a pre-shipping storage area. The grinder operator attempts to segregate castings after a fashion, but the attempts are not too successful. This results in confusion for the shipping room.	**Provide** *tote boxes and pallets* (for larger castings) for castings to be placed in after shakeout. Provide a fork truck to move these tote boxes of castings to the core shakeout area. This should speed up handling to the cleaning area by about three times. **As cores** are shaken out of the castings, they could be replaced in the *tote boxes* or on *pallets* and moved as unit loads to the barrel blast. The entire tote box could be inserted in a special skid hoist rig for loading the blast, thus avoiding another handling operation. Upon completion of the blasting operation, castings would be allowed to fall into the same tote box. Tote boxes or pallets of castings would then be transported to a pre-grinding storage area to await chipping and grinding. As a grinder operator finished a unit load of castings a fork truck would pick up and transport work to his bench and remove the finished work. The finished work would be transported to the pre-shipping storage area and cataloged as to customer. From studies, the above arrangement will result in about a 20 per cent increase in operators grinding and chipping time, reduce substantially the storage areas, and greatly reduce confusion.	**The fork lift truck with tote boxes and pallets will provide the efficiency and flexibility needed and is the least expensive solution.**
Shipping	Two men are employed full-time to segregate, record, prepare bills of lading, and load castings. The present method is as follows: Upon completion of an order or when a truck load of castings for regular customers has been accumulated, transportation is ordered. A trailer is backed into the end of the foundry under a five-ton bridge crane, castings are weighed and then picked up with chain hooks and placed on the trailer. This cycle is followed until all castings are loaded or a trailer has been filled.	NOTE: It is recommended that the sale of castings be placed on a piece basis, rather than a pound basis, making it unnecessary to weigh each casting as it is shipped. **A program** of unit segregation loads similar to that recommended for the cleaning room could be started. A loading dock inside the end of the foundry would be excavated, with the low end arranged to accept a dock board. Unit loads would be picked up with a fork truck, positioned in the trailer, the castings would be removed from the pallet and the fork lift would return to storage for another load. This would eliminate one man. **Use the** same arrangement as above, however, provide a hydraulic lift device to raise the fork truck to trailer height rather than building dock.	**The hydraulic lift for the fork truck would be several thousand dollars cheaper and would be a sufficient solution to the handling problem.**

This article is based on a paper, "*Materials Handling in the Foundry*," which was presented at an Industrial Engineering Session of the 1957 AFS Castings Congress.

Classified Advertising

FOR SALE, HELP WANTED, PERSONALS, ENGINEERING SERVICE, ETC., set solid . . 25¢ per word, 30 words ($7.50) minimum, prepaid.

POSITIONS WANTED . . 10¢ per word, 30 words ($3.00) minimum, prepaid. Box number, care of **MODERN CASTINGS,** counts as 10 additional words.

DISPLAY CLASSIFIED . . Based on per-column width, per inch . . 1-time, $18.00; 6-time 16.50 per insertion; 12-time, $15.00 per insertion; prepaid.

Help Wanted

FOUNDRY RESEARCH SUPERVISOR

Well-known research organization has excellent opportunity for a man with minimum of 10 years practical Foundry experience and good fundamental knowledge of metallurgy. This individual will supervise the diversified technical programs of the Foundry Section of our large Metals Research Department. He should have a minimum of a B.S. degree, be capable of directing a variety of Foundry activities as well as maintaining close customer contact.

Located in the Midwest, we offer a generous relocation allowance along with excellent vacation, insurance and retirement benefits, and the opportunity for professional and personal growth.

Please send complete resume. All replies will be treated as confidential.

Box No. D-66

MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.

PROCESS ENGINEER-CONN.

Investment casting company offers excellent position to young mechanical or metallurgical Engineer (non-degree, but experienced applicant acceptable). Opportunity for ambitious man.

Resume to **Box No. MCM 725**
125 West 41st Street, New York City.

SALES ENGINEER A well-known, long established foundry and manufacturing concern requires the immediate services of a qualified Sales Engineer. This company presents an unusual opportunity since it is a producer of steel, ductile iron, and engineering grades of gray iron. It also maintains large machine-shop facilities. Man must have sales ability and be equipped with proper technical training to call on large users of ferrous castings. **Box No. D-64, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

MANUFACTURERS AGENT WANTED

Several exculsive territories open to men with experience in melting practices. An opportunity to make real money selling the nationally advertised **REVECON** and **REVERBALE** Furnaces. Leads furnished. Submit details and other lines carried to

INTERNATIONAL FOUNDRY SUPPLY CO.
Box 1053, Reading, Pa.

Positions Wanted

TECHNICIAN desires responsible position with progressive firm. Wide experience in the field of Cast Iron and Steel. Strong in general foundry practice and quality control. Castings weight from lbs. to 50 tons. Mechanical engineering training. Employed at present. Age 36. **Box No. D-68, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

FOUNDRY MANAGER or Chief Industrial Engineer B.S. in Metallurgical Engineering, 1938, now in charge of industrial engineering in large captive foundry. Know steel, brass, gray and malleable iron. Develop and install incentive plans, production control, material control, cost systems, and equipment requirements. Locate anywhere in U.S.A. **Box D-67, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

Products Wanted

ESTABLISHED DISTRIBUTOR and representative with active sales force needs additional items. We are interested in servicing Texas, Oklahoma, Louisiana, on an exclusive basis. **Box No. D-65, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

For Sale

CONNERSVILLE 24 cu ft positive pressure blower #2812; pulley drive. Also Louden monorail track pouring system 400', forty trolleys, switches, curves. **FOR SALE. COMSTOCK-CASTLE STOVE COMPANY, QUINCY, ILL.**

NON-FERROUS FOUNDRY

West of Milwaukee, Wis. Fireproof building, large parking area, room for expansion, making castings for many well-known firms, opportunity unlimited, well established, owner moving south. **Box No. 71, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

FURNACES FOR SALE

10 used Heat Treating Furnaces, and two 7-ton gantry cranes, good condition, priced to sell.

BAER STEEL PRODUCTS. INC.
Box 1428
Boise, Idaho

Engineering Service

SESSIONS ENGINEERING CO.

Consulting Foundry Engineers
Modernization, Processing Layouts
Cost Reduction Quality Control
Product—Machine Control
Architectural Design
One North La Salle St., Chicago 2, Ill.

WESTOVER CORPORATION
Consultants
Exclusively serving the foundry industry since 1930
Mechanization—Modernization
Labor Relations—Incentives—Systems
Cost and Production Control
Plant Layout—Management
3110 W. Fond du Lac Ave., Milwaukee 10, Wisconsin

Wanted to Buy

TRANSACTIONS AFS back volumes and sets—wanted to buy for cash, also other scientific and technical Journals. A.S.F. ASHLEY, 27 E. 21st Street, New York 10, N.Y.

USING TOO MUCH COKE?

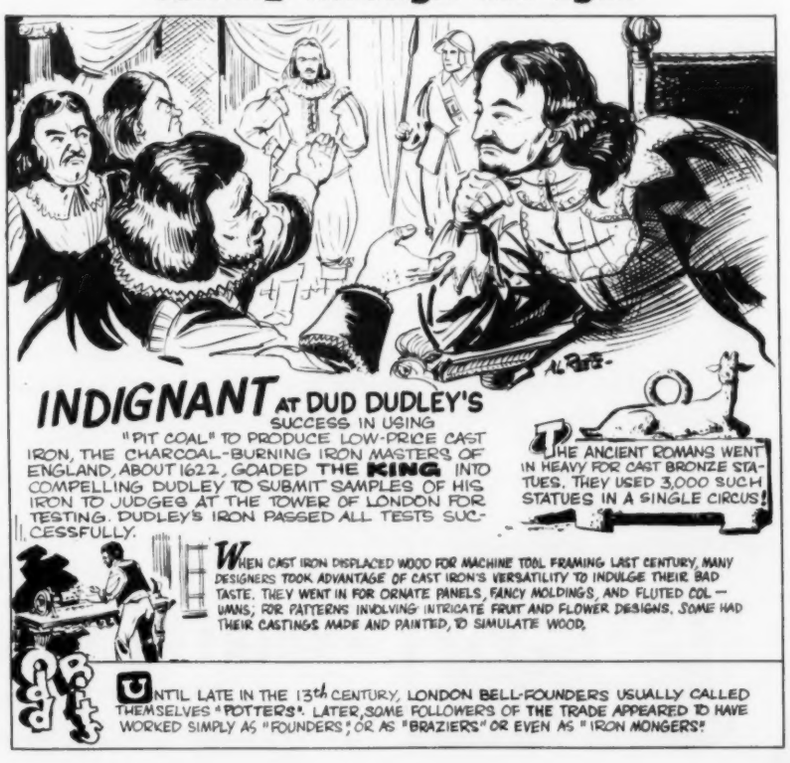
Why not talk this over with one of our metallurgists with a view to taking advantage of the superior quality of Semet-Solvay Foundry Coke in reducing your melting costs.

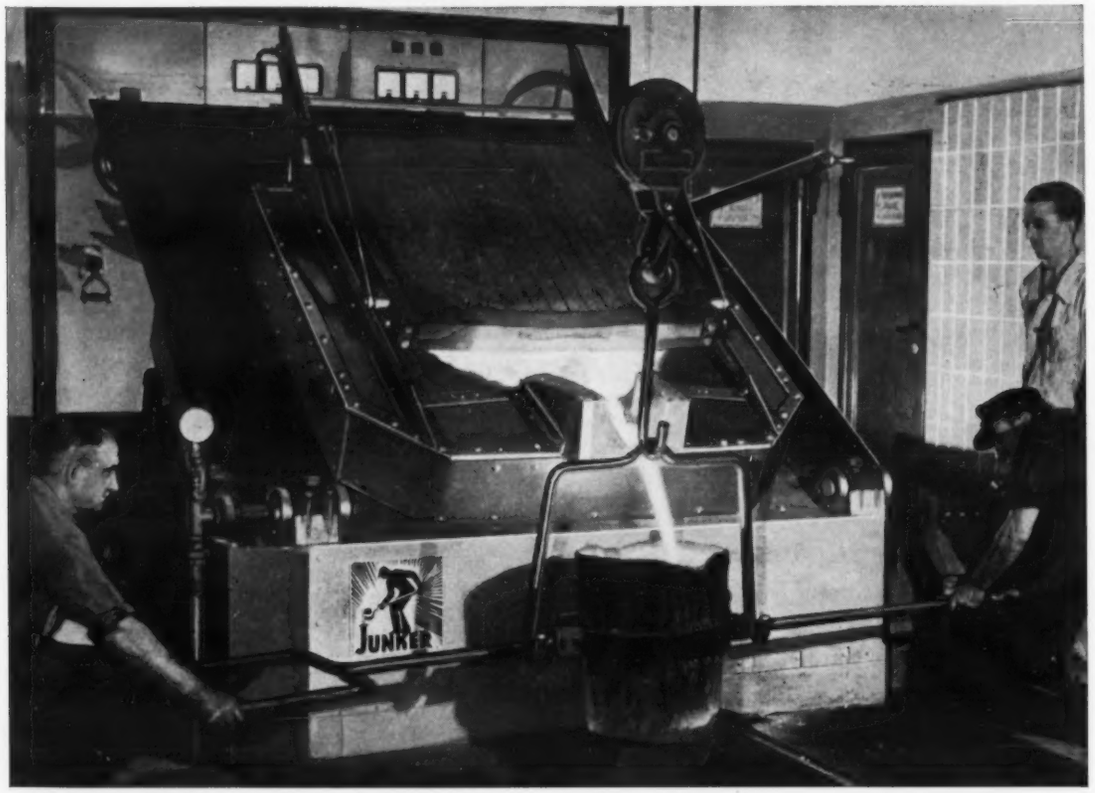
SEMET-SOLVAY DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 Rector Street — *New York 6, N. Y.*
Buffalo • Cincinnati — Cleveland • Detroit
In Canada: SEMET-SOLVAY COMPANY, LTD., Toronto
Western Distributor: WILSON & GEO. MEYER & CO., San Francisco

For Better Melting

Circle No. 165, Page 7-8

casting through the ages


INDIGNANT AT DUD DUDLEY'S
SUCCESS IN USING "PIT COAL" TO PRODUCE LOW-PRICE CAST IRON, THE CHARCOAL-BURNING IRON MASTERS OF ENGLAND, ABOUT 1622, GOADED THE KING INTO COMPELLING DUDLEY TO SUBMIT SAMPLES OF HIS IRON TO JUDGES AT THE TOWER OF LONDON FOR TESTING. DUDLEY'S IRON PASSED ALL TESTS SUCCESSFULLY.
THE ANCIENT ROMANS WENT IN HEAVY FOR CAST BRONZE STATUES. THEY USED 3,000 SUCH STATUES IN A SINGLE CIRCUS!
WHEN CAST IRON DISPLACED WOOD FOR MACHINE TOOL FRAMING LAST CENTURY, MANY DESIGNERS TOOK ADVANTAGE OF CAST IRON'S VERSATILITY TO INDULGE THEIR BAD TASTE. THEY WENT IN FOR ORNATE PANELS, FANCY MOLDINGS, AND FLUTED COLUMNS; FOR PATTERNS INVOLVING INTRICATE FRUIT AND FLOWER DESIGNS. SOME HAD THEIR CASTINGS MADE AND PAINTED, TO SIMULATE WOOD.
UNTIL LATE IN THE 13th CENTURY, LONDON BELL-FOUNDERS USUALLY CALLED THEMSELVES "POTTERS". LATER, SOME FOLLOWERS OF THE TRADE APPEARED TO HAVE WORKED SIMPLY AS "FOUNDERS", OR AS "BRAZIERS" OR EVEN AS "IRON MONGERS"!



A NEW METALLURGICAL TOOL FOR THE PRODUCTION OF HIGH QUALITY CAST IRON

We offer to the American industry the AJAX-JUNKER 60 cycle coreless induction furnace for melting or superheating cast iron, and particularly for the production of ductile cast iron. The AJAX-JUNKER is economical in foundries with intermittent operation and frequent alloy changes. It melts loose turnings with high recovery.

Electromagnetic stirring of the melt enables close control of composition. It speeds up the recarburizing rate and the solution of alloy ingredients.

High temperatures required for many quality castings are easily attained. Uniform heat is generated within the melt and the furnace lining is at a lower temperature.

The photograph shows a 6-ton Junker coreless induction furnace in a German foundry.

May we explore the possibilities of this new method with you?

AJAX USA

60 CYCLE INDUCTION MELTING

ENGINEERING CORPORATION

TRENTON 7, NEW JERSEY

Associated Companies: Ajax Electrothermic Corporation — Ajax Electric Company

Circle No. 147, Page 7-8

advertisers and their agencies

Allied Chemical & Dye Corp. 79
Ajax Engineering Corp. 80
Agency—Eldridge, Inc.
American Colloid Co. 69
Agency—Robert A. Gallagher
American Foundry Flask Co. 70
Agency—Cary-Hill Inc.
American Foundrymen's Society, Book Dept. 61
Arcair Company 65
Agency—Bayless-Kerr Co.
Archer-Daniels-Midland Co. 12-13
Agency—Bayless-Kerr Co.

Beardsley & Piper 22-23
Agency—Ladd, Southward & Bentley, Inc.

City Pattern Foundry & Machine Co. 2
Agency—Gray & Kilgore, Inc.
Cleveland Flux Co. 14
Agency—Brad Wright Smith Adv., Inc.
Corn Products Sales Co. 21
Agency—C. L. Miller Co., Inc.

Delta Oil Products Co. 5
Agency—Cormack, Imse, Beaumont, Inc.
Dow Corning Corporation 56
Agency—Church and Guisewite Adv. Inc.
Dresser Industries 27
Agency—Hayes, Wootters & Troxell, Adv.
E. I. du Pont De Nemours & Co., Grasselli-Industrial Div. 76
Agency—Batten, Barton, Durstine & Osborn, Inc.
Durez Plastics Division 60
Agency—Comstock & Company

Eastern Clay Products Dept. 17-18
Agency—C. Franklin Brown, Inc.
Eastman Kodak Co. 57
Agency—J. Walter Thompson Co.
Electro Metallurgical Co. 72
Agency—J. M. Mathes, Inc. Adv.

Fanner Manufacturing Co. 1
Agency—Allied Advertising Agency, Inc.
Foundry Educational Foundation 67
Agency—Wellman-Buschman Co.
Foundry Services, Inc. 75
Agency—Kight Advertising Inc.

Globe Steel Abrasive Co. 6
Agency—Coleman Todd & Associates

Hanna Furnace Corp. 4
Agency—Campbell-Ewald Co.
Holtzman Metal Co. 70
Agency—Milton Sharp, Adv.
Hooker Electrochemical Co. 60
Agency—Comstock & Company
Frank G. Hough Co. 10
Agency—Erwin R. Abramson, Adv.

International Minerals & Chemical Corp. 17-18
Agency—C. Franklin Brown, Inc.
International Nickel Co. 19
Agency—Marschalk & Pratt

Jeffrey Manufacturing Co. 16
Agency—Griswold-Eshleman Co.
Johns-Manville Corp. 25
Agency—J. Walter Thompson Co.

Keokuk Electro-Metals Co. 24
Agency—Waldie & Briggs, Inc.
Keystone Abrasive Wheel Co. 59
Agency—W. S. Walker Adv., Inc.

Lectromelt Furnace Co. ...Inside Front Cover
Agency—Griswold-Eshleman Co.
Linde Company 9
Agency—J. M. Mathes, Inc. Adv.
Link-Belt Company 11
Agency—Klau-Van Pietersom-Dunlap Assoc.

Magnet Cove Barium Corp. 27
Agency—Hayes, Wootters & Troxell, Adv.

National Steel Corp. 4
Agency—Campbell-Ewald Co.
Neff & Fry Company 65
Agency—Parker Advertising Co.

North American Refractories Co. 68
Agency–Clifford A. Kroening, Inc.

Ohio Ferro-Alloys Corp. 15
Agency–Huffman & Co.
Oliver Machinery Co. 71
Agency–Webb J. Van Dyke Adv.
Orefraction Inc. 66
Agency–Smith, Taylor & Jenkins. Inc.

Pettibone Mulliken Corp. 22-23
Agency–Ladd, Southward & Bentley, Inc.
Philadelphia Quartz Company 70
Agency–The Michener Company
Pittsburgh Coke & Chemical Co. 64
Agency–W. S. Walker Advertising, Inc.
Pittsburgh Crushed Steel Co. 6
Agency–Coleman Todd & Associates

Roura Iron Works, Inc. 20
Agency–Marsteller, Rickard, Gebhardt & Reed, Inc.

Semet-Solvay Div.
Allied Chemical & Dye Corp. 79
States Engineering Corp. 71
Agency–Tri-State Advertising Co., Inc.

Frederic B. Stevens, Inc. ..Inside Back Cover
Agency–Zarker Adv. Co.

Thiem Products, Inc. 63
Agency–Ken Seitz & Associates, Inc.

Union Carbide Corp. 72
Agency–J. M. Mathes, Inc. Adv.

Vanadium Corp. of America 26
Agency–Hazard Advertising Co.

Wedron Silica Co. 58
Agency–Armstrong Adv. Agency
Whiting Corp. .....Back Cover
Agency–Waldie & Briggs, Inc.

This index is published as a convenience to the readers. While every care is taken to make it accurate MODERN CASTINGS assumes no responsibility for errors or omissions.

Canadians Hear How Nickel Improves Metal Qualities

Nickel's importance to the foundry industry was explained at the April meeting of the AFS Eastern Canada Chapter by J. S. Vanick, International Nickel Co.

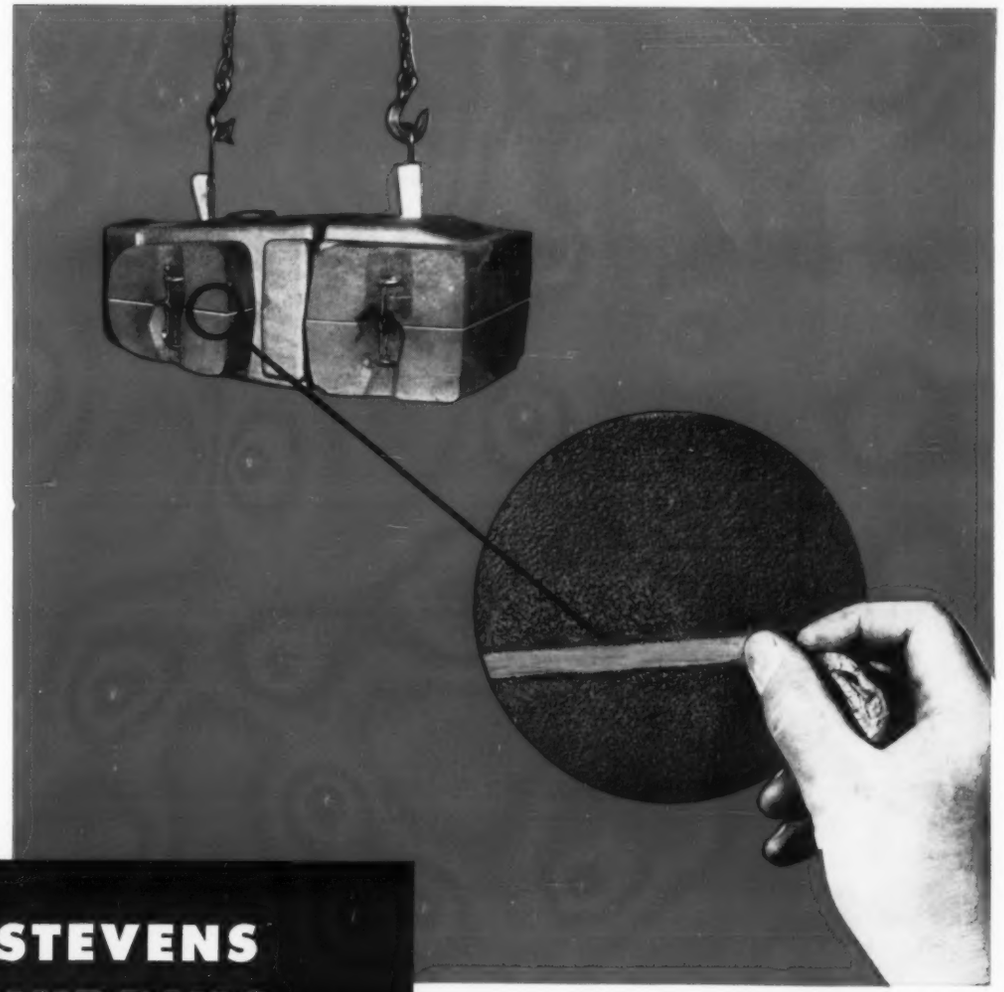
Ferrous alloys containing 1-70 per cent nickel form the nickel-chromium heat-resisting alloys used in such industries as furnace equipment, petroleum, power, cement, glassmaking, and aeronautical.

In the low-alloy cast steels, the speaker pointed out, 1-2 per cent nickel is used to increase strength and higher load carrying qualities. The additions also increase yield strengths, hardness and wear-resistance. Nickel also improves air hardening, shock resistance, resistance to fatigue, and low temperature toughness. The properties find applications in such fields as agriculture, ordnance, automotive, and marine manufacturing.

The use of nickel in bronzes was illustrated by alloys containing 5 per cent each of nickel and tin. These have higher strengths than most bronzes and strengths can be more than doubled by heat treating.

Another contribution of nickel to the castings industry is in the aircraft field where high-cast temperature components have replaced forgings. Many high temperature alloys can not be forged.

Mr. Vanick's talk was followed by a motion picture, "Mining for Nickel," prepared by International Nickel Co.



STEVENS MUDDING COMPOUND.....gives perfect results in unskilled hands

Your core workers will like the way Stevens Slick-Seal Mudding Compound always goes on smooth and easy. There's no crumbling, rolling or balling up behind thumb or finger. They'll like the way either black or white Slick-Seal easily washes off their hands with just plain water.

This new compound remains plastic and workable. Yet light applications of Slick-Seal dry in one to two hours; heavier applications in four to five hours. Edges won't shrink or curl when subject to oven heat . . . flowing metal won't dislodge Slick-Seal. Stevens mudding compound is a high heat resistant facing. It prevents fins or burn-in at pasted joints.

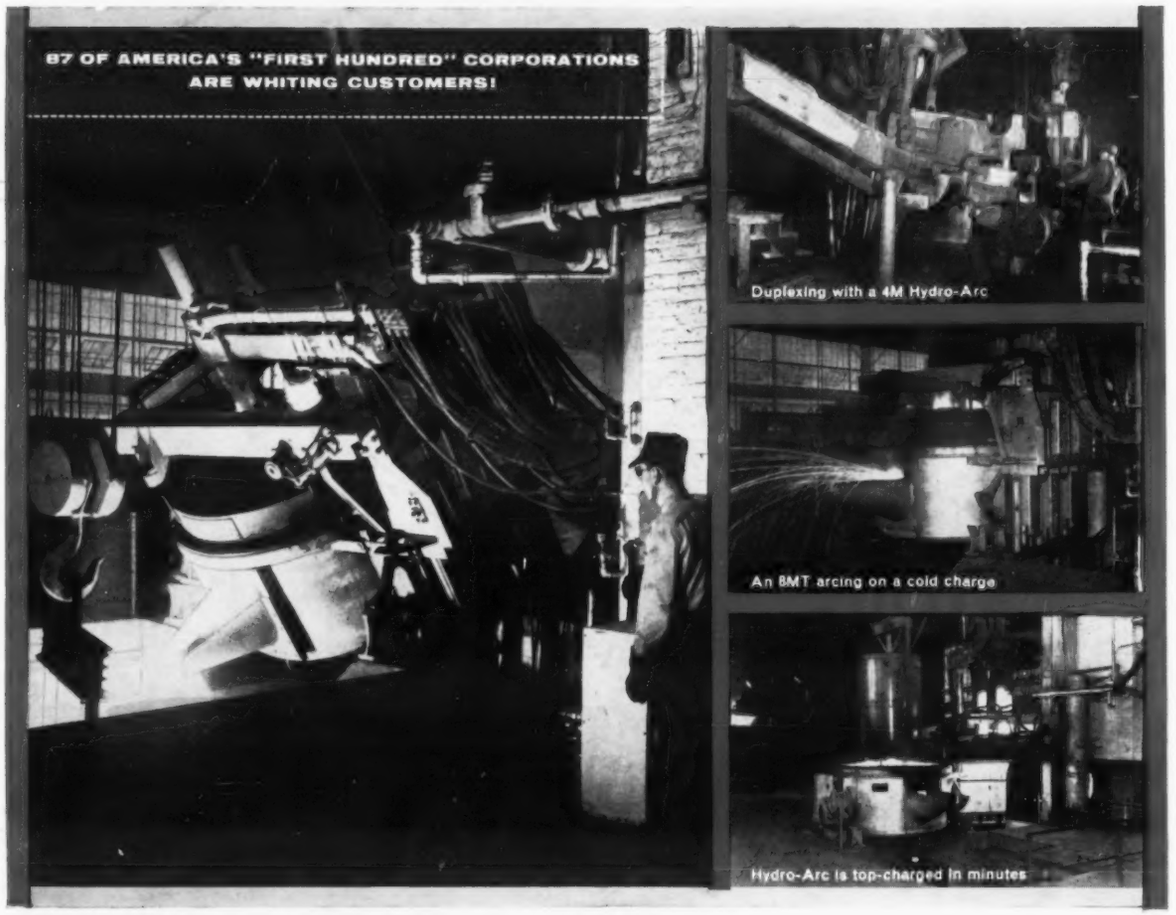
Why not order Slick-Seal Mudding Compound today?

FREDERIC B. STEVENS INCORPORATED
EVERYTHING FOR A FOUNDRY
DETROIT 16, MICHIGAN

Have you tried Steveco, CO_2 binder? It really does the job.
Write for Stevens Technical Bulletin FA-130!

Circle No. 167, Page 7-8

modern castings


87 OF AMERICA'S "FIRST HUNDRED" CORPORATIONS ARE WHITING CUSTOMERS!
Duplexing with a 4M Hydro-Arc
An 8MT arcing on a cold charge
Hydro-Arc is top-charged in minutes

Hydro-Arc...

Engineered for today's melting needs

Engineered for today's high production capacity, the Hydro-Arc Electric Furnace is the answer to all your prime melting and duplexing needs. It has fewer moving parts . . . is easy to operate and maintain—economical, too! New hydraulic power transmission . . . automatic clamp and arm for fast, safe electrode slipping . . . patented repositioning equipment for a constant arc even under the most adverse conditions—they're but three of the many advancements that upgrade melting efficiency, produce a better product. In addition, Hydro-Arc's top charging reduces down-time, helps assure more-melt-per-man-hour! Investigate Hydro-Arc today. Send for Bulletin FY-168, the booklet that gives the details! *Whiting Corporation, 15628 Lathrop Avenue, Harvey, Illinois.*

WHITING

FOUNDRY EQUIPMENT

MANUFACTURERS OF CRANES; TRAMBEAM HANDLING SYSTEMS; TRACKM OBILES; FOUNDRY, RAILROAD AND CHEMICAL PROCESSING EQUIPMENT

Circle No. 169, Page 7-8